Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

Vol. LXIV. MAY, 1923 No. 5

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Price: Single copy 25 cents. Annual subscription in U. S. $2.00; Canada, $2.40; Foreign, $2.75.

MUNICIPAL AND COUNTY ENGINEERING is published monthly by Engineering Publishing Company, 702 Wulsin Building, INDIANAPOLIS, INDIANA, A. P. Fox, President, J. H. Pritchard, Secretary.

Changes of address, subscriptions and remittances should be addressed to MUNICIPAL AND COUNTY ENGINEERING, Indianapolis, Indiana. Editorial and business communications should also be addressed to 702 Wulsin Bldg., Indianapolis, Ind.

Editorial and Advertising Offices also at 702 Wulsin Bldg., Indianapolis, Ind. Samuel C. Hadden, Editor and General Manager.

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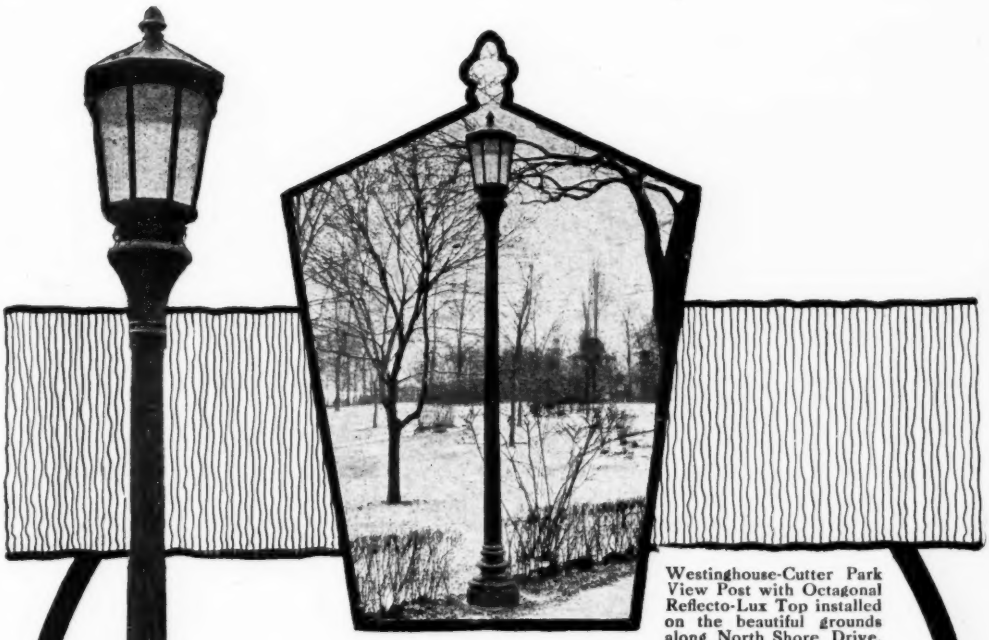

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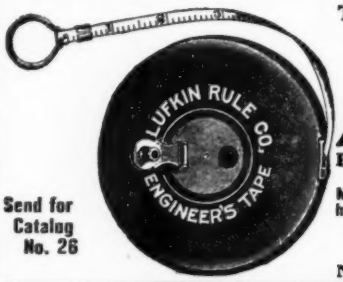

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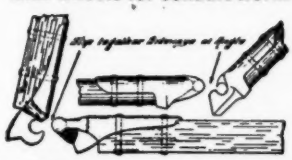

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EDITORIALS

WHEN IMPROVED HIGHWAYS PARALLEL INTERURBAN RAILWAYS

When improved highways parallel interurban railways it is only a question of time until motor truck and bus traffic reaches proportions that cut into the rail receipts and this, of course, precipitates a form of warfare with all the unpleasant manifestations commonly associated with a business war. As long as the truck and bus lines act merely as feeders to the rail lines they are in high favor with the railway owners, but as soon as direct competition begins, friendship ceases and the fight is on. Naturally enough the interurbans are interested in self preservation but in their efforts to protect themselves they use many arguments, the soundness of which the public should examine with great care. The public interest is paramount and if it serves the convenience and economic needs of the public to have truck and bus lines operating over a certain highway joining two or more important centers of population, and if the operation of these truck and bus lines injures an interurban or short line steam railway which they parallel, the thoughtful section of the public can hardly escape the conclusion that the rail lines are simply out of luck.

It is a serious question, right now, whether or not the interurbans can long survive. Many feel that these utilities are entering a state of functional obsolescence. All will hope that the interurbans can keep operating at a profit by improving their transportation service, especially in freight and long haul passenger traffic and by selling electric energy for power and lighting purposes, for no one likes to see invested capital lost, but the owners of these utilities must realize that it is up to them to survive through service and not through the elimination by law of truck and bus competition, however skillfully this elimination may for a time be disguised as "regulation." The interurbans use many arguments against motor transport lines which will not stand up against the force of logic and common sense. Much complaint is made that trucks and buses operate over the public highways, built at public expense, while the interurbans must buy their right-of-way, do their own grading and construction, pay for their tracks, etc. After reciting at length these and other points of fundamental difference between rail lines and rail traffic, and highways and highway traffic, the rail magnate or manager suddenly shifts his position and expects the public to regard as similar two forms of transportation which he has demonstrated are fundamentally dissimilar. Comparison from any standpoint shows that the interurbans are under a natural handicap, in this struggle, and they can scarcely hope to persuade the public to impose artificial handicaps on highway transport merely to safeguard the investments and profits of the rail owners. Evolution and progress have always injured what they have rendered obsolete, as a matter of course, while contributing to the general advancement and welfare of the race.

Many of the fallacies in the arguments advanced on behalf of the interurbans become obvious when we consider what the effect of commercial air traffic may be on highway, as well as on rail transportation. If, or when, air traffic becomes commercially feasible and well developed in this country, and it is pointed out that air craft do not require roadways of any sort on which to run, like tracks and pavements, that air transport does not require bridge and drainage structures, and has other natural advantages over both rail and highway transport, are we to be asked to impose artificial handicaps on the air operator merely to offset the natural handicaps under which rail and highway transport must always operate?

As we have intimated, if the interurbans could have all the profitable intercity business while the truck and bus lines were required to run out into the forests and swamps, if they ran at all, the interurbans would feel that all was well, but the public would derive little benefit from such a condition, to say nothing of truck and bus operators.

Before the steam railways came there were many cities. The railways naturally first connected the largest cities, passing

also through as many smaller cities as was considered feasible en route. Other towns grew up along these steam railways. When the interurbans came they were very naturally and very properly located where they would serve the public best and this naturally caused them to parallel the steam railways which had developed the line of travel. It will be remembered the steam lines didn't like this very well. Incidentally, the highways were here first and all rail lines have paralleled the highways, often overshadowing the importance of a highway for many, many years. Following the same sensible procedure the highways carrying the heaviest traffic were the first ones selected for hard surfacing and these roads are the ones connecting the larger cities, thus throwing the rail lines and the highways into direct competition, just as the electric lines came into competition with the steam lines. The electric line men are now talking like the steam line men did 20 years ago.

It is well to keep these fundamentals in mind in examining the arguments of the interurbans against the improvement and use of highways.

TRUCK AND RAIL COOPERATION

In discussing truck and rail cooperation it is well to point out at the outset that this is likely to exist only where the railroad is one of considerable mileage. Occasionally we see expressions of friendship for motor transportation by some rail man and if we do not look closely we are likely to miss the point that he represents a long road, a trunk line, in practically all cases. Short haul freight is not profitable to long railroads, but it is to the short railroads if the short lines make any profit at all. The truck is a real help to the long line, but may be a dangerous competitor to the short one. Thus we can expect little true cooperation between short line railroads and motor transport, now or hereafter.

Up to about 30 miles, as a rule, the truck, on good roads, is more economical than the railroad; for some conditions and some classes of freight the truck has the advantage for distances considerably exceeding 30 miles, but that figure seems to be a fair average based on experience to date.

The great majority of intercity trucking enterprises have come to grief either because the operator has attempted the economically impossible or because he has known little or nothing of cost accounting and has fixed his rates at less than the cost of the service. The possibilities and limitations of the truck will not really become known until it is taken up by men of brains and responsibility who will learn their costs and charge accordingly.

One prominent rail official representing a trunk line (the Erie) recently said: "The time has come when the nation's railroad facilities are so heavily taxed by the enormous tonnage offered that there is only one way in which we may get freight hauled, and that is by asking business men to employ motor trucks for the short hauls, say, up to 30 miles or so, thus releasing railroad facilities and equipment for the longer haul which can go by no other means."

He frankly and truly states, also, that freight destined for short distances can be transported by motor truck at a price cheaper than by rail to the shipper and, therefore, to the consumer. This is due to the fact that the cost of handling in railway terminals, especially in the larger cities, is so great.

The rail official quoted also said: "All who have kept up with our modern transportation problems admit that the motor truck is the necessary adjunct and not the competitor of the railroad, indispensable to economic short hauling. The railroads will have to be rid of the burden of the short haulage into and out from cities of magnitude, not only because it doesn't pay the railroad, but also because it doesn't pay the shipper or the consumer. Isn't it right, isn't it sound social policy, isn't it just to all concerned to devote facilities and equipment to the longer haul freight, which if not moved by rail cannot be moved at all, and ask the business men and manufacturers to get their short-distance hauling done by motor trucks?"

This railway official has developed a very sound conception of truck and rail cooperation. Proper coordination of the longer and stronger railroads with well financed and well officered motor transport companies will help greatly in clearing up the transportation muddle.

ESSENTIAL FEATURES IN CONCRETE PAVEMENT DESIGN

To the Editor:—

In reading the article by Mr. Warren in the March issue of "Municipal and County Engineering" on "Developments in Concrete Pavement Design," I find much that is of interest and miss much that seems to me important.

It is now 30 years since the first cement concrete streets were built in this country and a vast amount of literature concerning the subject has been produced without authoritative answer to either of several important questions which must have occurred to the engineer who designed the first concrete pavement and answered by him in his own way. The problems all of us meet when we plan a pavement are the same and must be determined in each case in accordance with the conditions peculiar to that case. They are, generally speaking: (a) the preparation and protection of the subgrade or foundation of the pavement, (b) the design of the slab to meet the requirements of present and future traffic, (c) the proper finish of the surface so that it will give the least resistance to traction and the greatest resistance to abrasion, and (d) curing so as to preserve the qualities that have been built into the pavement. And frequently in municipal practice the further problem of how to prevent someone, either financially or officially interested, from so changing the plan as to seriously injure the pavement.

I have seen but few pavements in the design of which all of these problems have been fully solved.

The subgrade may be well prepared but is rarely well protected unless nature has provided the protection.

A great deal has been said in advocacy of sub-drainage of the roadbed, and I would emphasize all of it, but no amount of sub-drainage will prevent a stiff, waxy, clay subsoil from becoming entirely too wet, during a wet Fall, for the good of a concrete slab resting upon it. Neither will a well finished subgrade of ordinary soil give adequate support to the slab when the slab is subjected to the warping effect of unequal expansion of top and bottom due to difference of temperature.

In my own practice I have endeavored to meet these problems by means of: first, adequate curbing, extending well below the subgrade and set on a porous foundation which provides drainage; second, a cushion of clean sand and gravel or crushed rock spread upon the subgrade. Three inches of sand and gravel or 4 ins. of crushed rock, are sufficient usually to prevent forming a frost bond between the slab and the subgrade.

The design of the slab will necessarily be made with reference to the warping effect of unequal expansion. For this reason I have prefered to construct the slab with a longitudinal joint in the center whenever the width is greater than 18 to 20 ft. I have met with considerable official and popular opposition to this and have, in some instances, been overruled. In each such instance the result has been unsatisfactory. In this city we have several cases in which pavements, identical in other respects and constructed the same season, show marked contrasts in their present condition and in each case the advantage is in favor of the center joint.

Other questions enter into the design of the slab, chief of which are the proportioning of the ingredients and the proper thickness. The prevailing opinion of writers seems to favor rich mixtures and thick slabs, which probably are justified by laboratory practice and tests. But I am quite convinced that concrete may be too rich and consequently have an undue tendency to crack. I have secured the best results with a 1:2½:4 mix, with the surplus water well worked out or absorbed by a rich mixture of cement and sand floated into the top when finishing.

As to the proper thickness of slab I am entirely open to conviction in any case. I paved a lumber yard in 1912 with a 4-in. slab on filled ground. It is subject to very heavy traffic, both as to weight and number of loads, but is in excellent condition and shows but little effect of wear.

I daily observe 8-in. slabs on the state highway, subject to lighter traffic, showing the effect of abrasion and badly cracked after less than half the period of service. So I am satisfied that the question must be solved with reference to other conditions as well as the volume and weight of traffic.

Probably the treatment of the foundation is the most important factor in determining the slab thickness. It is doubtless best to play safe by making it thick enough. I believe that, given a subgrade fit to build on, 8 ins., and possibly less, is ample thickness for the support of any traffic. And this gives a margin of 2 ins. for loss by abrasion.

The conclusions I draw from all my observations and experience, supplemented by the experience of others which have come to my knowledge, are briefly as follows:

1. That the destructive forces against which we must build protection into the road are: (a) The warping effect of unequal expansion which invariably produces longitudinal and diagonal cracks during the second and third season whenever the slab is too large, especially when it extends across a crown. (b) Frost action upon the subgrade either in heaving or in freezing the slab to the moist earth which continues to expand while the slab contracts after such adhesion. Frost probably plays a considerable part in the destruction of heavily reinforced pavements, owing to the great difference between the expansion of steel and of concrete. (c) The weight and abrasion of traffic.

2. If faults develop in the pavement they are due to one or more of these causes and that all design and construction should be carried out with a constant purpose of reducing their effects to the minimum.

3. Maintenance charges are, largely, payment for the failure of the builder to produce an ideal job. This is especially true of maintenance during the first few years. Of course the ideal job presupposes ideal conditions of soil either natural or constructed. It also presupposes an adequate plan faithfully carried out.

However I did not set out to write a treatise but merely to record a few observations along lines which have received less attention from writers than their importance merits.

There is much to be determined in this as in other fields of activity and I submit these observations with the fullest appreciation of the possibility that accurate data obtained from comprehensive surveys and elaborate field experiments may modify them somewhat. But the subjects to which they relate will always remain of prime importance.

Very truly yours,

CHAS. F. NESBIT.

Dixon, Ill., April 16, 1923.

TRAFFIC CENTER LINES ON ROADWAYS

(Editor's Note: Following is the full text of the report of the Committee of the National Highway Traffic Association on "Traffic Center Lines on Roadways," presented at the annual meeting of the Association on May 10, 1923, by the chairman, Mr. Frank T. Sheets, Illinois State Superintendent of Highways, Springfield, Ill.)

The use of traffic center lines on highways is becoming more and more popular in the United States. In the case of a road having a paved width sufficient to accomodate two lines of traffic, the safety of the highway users may be increased from 25 to 50 per cent by the addition of a traffic center line. This conclusion has been reached after an observation of the habits of traffic on two track roads where a center line has been introduced. Further it is based upon the unsolicited complimentary remarks which have been received from the traveling public immediately after such a line was introduced.

When a traffic center line is used, the drivers no longer pass each other with a more or less uncertain clearance between the vehicles, but approach each other with confidence, using the center line as a positive visible gauge on the driver's side, and knowing that the clearance thus afforded will insure absolute safety in passing without any danger of running off the unseen outside edge of the pavement.

On curves the traffic center line is of even greater advantage than on the tangents, and even if not used on the latter, it should be painted on all curves having a radius less than 1,000 ft. This center line should extend not less than 400 ft. beyond the beginning and ending of the curve.

In the case of the so-called non-rigid or flexible types of pavement construction on macadam or other flexible bases, the use of traffic center lines might tend to force traffic into well defined lanes and thus cause rutting or undue wear. However, on heavily traveled roads, the safety of the traveling public is of greater importance than the safety of the pavement surface. In the case of the so-called rigid types of pavement, such as portland cement, concrete, brick, bituminous concrete or sheet asphalt on a concrete base, which are the predominating types in this country, the traffic center line will materially increase the structural safety of the pavement by tending to eliminate travel near the extreme edges of the pavement, where the outside edges and the unprotected corners caused by construction joints or by transverse contrac-

tion cracks are the most dangerous and critical sections from a structural standpoint.

One of the embarrassing defects encountered in concrete pavement slabs having a width greater than 16 ft. is the formation of unsightly longitudinal cracks brought about by the combined stresses produced by nature and traffic. To eliminate such cracks, the center of the pavement must be thickened to a dimension not justified by economy; however, this may easily be circumvented by introducing a longitudinal center construction joint dividing the normal two-crack country pavement having a width of 18 ft., into two 9-ft. sections. Slabs 9 ft. in width have never caused any difficulty so far as longitudinal cracking is concerned. By proper interlocking and tying together of these two 9-ft. strips, the interior portion of the pavement may be made practically as strong as an unbroken slab, and certainly far more efficient than a pavement divided by an irregular longitudinal crack. This center construction joint may be kept filled with bituminous material and painted with a line approximately 3 ins. in width. In this manner, the traffic center line and the longitudinal construction joint may be introduced in one operation, with the result that the unsightly longitudinal cracking is eliminated, traffic safety is assured, and highway engineers may cease to perpetuate the indefensible evil practice of causing doubt, criticism, and mistrust in the mind of the traveling public by designing and building pavements which fail structurally by longitudinal cracking even before traffic is introduced.

The combined center line construction joint and painted traffic center line are being used in the state of Illinois on all pavements built on the 4,800-mile state trunk line highway system which is being pushed to completion at the rate of 1,000 miles per year, and also on all county roads in the State.

SPECIFIC PRINCIPLES OF GOOD PROFESSIONAL CONDUCT FOR ENGINEERS

A compilation of specific principles of good professional conduct for engineers has just been prepared by the Practice Committee of the American Association of Engineers, as requested by the Board of Directors, to supplement the code of ethics of the association. The principles, which follow, are stated in short sentences, and are based upon cases passed by the Practice Committee since 1919 and approved by the Board:

Part 1. *Relations of the Engineer to the Public*

1. The Engineer should regard his duty to the public welfare as paramount to all other obligations.

2. He should not use his professional standing as a means of sponsoring or promoting commercial or other undertakings of a speculative character.

3. He should scrupulously avoid connection, by act or omission, with any illegal or questionable undertaking or participation in any enterprise inimical to the public welfare.

4. He should not advertise in self-laudatory language or in any other manner derogatory to the dignity of his profession.

5. He should avoid any publicity giving the impression that technical service in technical matters can be dispensed with; or that technical proficiency along any line is easy of acquisition; or that exaggerated returns may be expected from any limited course of technical instruction.

6. He should avoid any questionable statements or any statements couched in language that would convey a false impression, in any of his reports, advertisements or articles.

7. When retained to report on any property or project, he should not accept as compensation any stock or other interest in the property or project, or any other contingent fee which could in any way consciously or unconsciously influence the nature of his report and its conclusions.

8. He should avoid entering into any private combination which would restrict free individual competition for professional employment. The matter of proper engineering fees and the methods of making proper tenders on engineering work should be left to professional organizations in order that their backing should inspire public confidence.

9. He should refrain from using any improper or questionable methods of soliciting professional work.

10. He should participate in clean politics and should strive to be a force to assist in the cleansing of politics.

11. He should take an active interest in the public welfare in behalf of which

he should ever stand ready to volunteer his special knowledge, skill and training for the use and benefit of mankind.

Part II. Relations of the Engineer to Clients and Employers

1. The engineer should pursue his professional work in a spirit of strict fidelity and full loyalty to his clients and employers.

2. He should inform a client or employer of any business connections, interests or affiliations which might tend to influence his judgment or impair the disinterested quality of his services.

3. He should accept compensation for his services in connection with any work from one source only, except with the full knowledge and consent of all the interested parties.

4. He should regard and maintain as confidential any information obtained by him relating to the business affairs and technical methods or processes of a client or employer.

5. He should not engage in any outside work without the full knowledge and consent of his employer.

6. When connected with any work, he should not accept commissions, outside employment, promise of employment, or any other consideration from a contractor engaged upon that work.

7. He should have no business dealings or connections with any client of his employer without the full knowledge and approval of his employer.

8. He should entertain no offers of employment or other considerations from a third party, when such may in any way influence his actions or decisions with respect to the relations which may exist between such third party and the Engineer's employer or client.

9. He should not accept commissions or other considerations for specifying or recommending supplies, equipment or service.

10. He should not split fees as commissions for securing work, nor work with other engineers on a split-fee basis unless assured that his client is not deceived thereby.

11. He should have no interest direct or indirect in any materials, supplies or equipment used in the construction work of his client or in any firms receiving contracts for his client's work without informing his client in advance of the nature of such interest and obtaining his sanction.

12. He should not engage in the independent practice of engineering without the knowledge and sanction of his employer, and under no circumstances should he compete with his employer on the basis of lower fees.

Part III. Relations of Engineers to Employes

1. The Engineer should treat his employes or subordinates in a spirit of fairness, with due regard and consideration for their personal welfare and professional advancement.

2. There should be a professional bond between employer and employe when both are engineers, which will dictate and impel reciprocal interest and mutual consideration.

3. The Engineer should pay adequate salaries commensurate with the importance and responsibility involved in the service.

4. He should encourage the professional pride of his employes or subordinates in their work and should offer them every means of protecting their reputations and the quality of the work entrusted to them by not interfering with the proper performance of the duties for which they are responsible.

5. He should recognize the freedom of his employes to change employment and should in no way hinder employes or subordinates in bettering their condition.

6. He should not discharge an employe, nor withhold employment from him, nor discriminate against him in any way on account of his affiliations or activities in any professional, political or religious organization.

7. He should respect his employe's right to freedom of thought, speech and outside activity as long as the same does not impair the efficiency and value of the employe's service.

8. He should see that his employe is adequately covered by insurance against risk of casualty arising from his work.

9. In advertising or offering employment, he should refrain from any misrepresentation as to the conditions and permanency of such employment.

10. If in public employ, he should assume the responsibility of consistently protecting the interests of his subordinates.

11. He should make every effort to provide steady employment for his employes and when forced to discharge an employe he should give the most generous notice possible and exert every reasonable effort to assist the employe in finding another position.

Part IV. The Engineer's Relations to Other Engineers

1. The Engineer should not by word, act or omission, injure falsely or maliciously, directly or indirectly, the professional reputation, prospects or business of another Engineer.

2. He should not attempt to supplant another Engineer after definite steps have been taken toward his employment.

3. If employed in conjunction with another Engineer, and by the same client, he should not review and comment conclusively upon the work of the other Engineer except with his full knowledge and consent or unless the connection of such other Engineer to the work has been previously terminated.

4. He should not use unfair means to effect his professional advancement or to injure the chances of another Engineer to secure and hold employment.

5. He should not attempt to inject his services into a project at the expense of another Engineer who has been active in developing it.

6. He should not interpose between other Engineers and their clients when unsolicited. When solicited, he should avoid any possibility of doing a brother Engineer an injustice.

7. He should not seek or solicit a position occupied by another Engineer.

8. He should not attempt to secure work on the basis of lower salaries or fees.

9. He should be courteous, fair, considerate in his dealings with other Engineers.

10. He should not criticise the work of other Engineers except when regularly engaged to do so; and he should not attempt to secure the work for himself through criticism.

11. He should not commercialize his affiliations with, or official position in, any technical organization.

12. He should not use his professional affiliations to secure the confidence of other Engineers in speculative commercial enterprises.

13. As a member of any professional organization, he should avoid any act tending to promote his own interest at the expense of the dignity and standing of the organization.

14. As an officer of a professional organization, he should sedulously avoid any appearance of using his position for personal advertising.

15. He should cooperate in upbuilding the Engineering profession by exchanging professional information and experience with his fellow Engineers and students of Engineering and by contributing to the work of engineering societies, schools of applied science and the technical press.

16. He should regard himself as a debtor to his profession and should dedicate himself to its advancement.

TRAFFIC ACCIDENTS IN RELATION TO STREET AND HIGHWAY LIGHTING

By Charles J. Stahl, Manager Illuminating Engineering Bureau, The Westinghouse Companies, South Bend, Ind.

The first use of street lighting was to prevent crime and the first illuminant was the pine knot or firebrand which served merely as a pathfinder in the primitive settlements of man. Then came lamps made from the skulls of animals or nut shells in which oil was burned. With the advance of civilization there came a growing tendency to do more and more of the world's work under artificial lighting. In the early days no one ventured on the streets after dark except on most urgent business and then only when accompanied by a body guard of torch and cudgel bearers. Even during the present generation there have been in many American cities certain sections dangerous to traverse after nightfall.

Street lighting has had a fascinating development which up to about 20 years ago was impelled almost entirely by man's desire for safety, comfort and peace of mind. The fundamental motive was crime prevention. Today it is still the fundamental consideration but other motives have grown to be of almost equal importance. Briefly stated these other considerations are:

1. Accident prevention.
2. The "City Beautiful" idea.
3. Business stimulation.

I am mentioning this to show that up to recent times the requirements of traffic were almost entirely neglected in the lighting of streets and as for highways what little has been done is hardly a beginning on the thousands of miles of intercity highways which along with the automobile have grown to such great importance in our national life. Fortunately the requirements of good street lighting from the standpoint of preventing crime are to quite an extent the requirements for safe and comfortable traffic, except that the latter requires higher intensities of lighting. But unfortunately no national

or civic organizations have consistently advocated and fostered the use of ample and efficient street lighting.

Our first thought is that the electric light companies should be its advocate, but they unfortunately are very often forced to enter into contracts in which the rates allow no profit and not infrequently the street lighting business is actually taken at a loss to the electric light company supplying the power. Naturally they make no effort to increase unprofitable business.

For its value as a business stimulator merchants have here and there fostered local improvements but no highway association, or other allied societies, have so far undertaken extensive propaganda or educational work on the value of good street and highway lighting which in comparison with most other public services is high in proportion to its cost.

The time has come when in connection with our street lighting we must recognize that we have entirely different problems to face than ten or even five years ago, and the cause is the automobile. To the development of modern high speed traffic brought about by its extensive use must be charged practically all of the increase in street-traffic accidents.

According to the latest surveys the total annual fatal accidents on the railways of this country are 7,800 as against 15,500 fatalities due to traffic accidents. Therefore, the loss of life in traffic accidents is twice as great as in railway accidents. As to an evaluation of the annual personal and other property loss from automobile accidents, Dr. F. S. Crum, statistician for one of the large insurance companies of this country, states that while an accurate computation is not possible, the annual sacrifice is fully $1,000,000,000.

In 1906 there were less than 400 deaths in the United States from automobile accidents while in this year the total will exceed 15,000 which is an increase of about 3,800 per cent and the total is steadily mounting higher.

Stringent traffic regulations and educational publicity work have brought good results in many districts but they cannot overcome the effects of faulty vision caused by inadequate and improper street lighting. To determine how much value should be attributed to the proper illumination of streets as a factor in the prevention of accidents, a survey was made in a representative group of cities. In order to obtain uniformity in the reports, blank forms were prepared by the Engineering Department of the National Lamp Works providing for a charting or accurate tabulation of all traffic accidents in a given city during the period of one year. On these data forms returns were obtained from 32 representative cities such as Philadelphia, Boston and others, with a combined population of over 7,000,000. The period covered by the returns was in most cases from the middle of 1919 to the middle of 1920. Some of the essential facts derived from the data compiled are in condensed form as follows:

1. That of the 31,475 accidents reported, 1,678 or 17.6 per cent were night accidents due to inadequate lighting.

2. Applying this rate to all cities of the U. S. we find that no less than 567 fatal accidents occur annually due to inadeqfiate lighting.

3. In addition to the suffering and loss of life an evaluation of the economic loss gives us the substantial amount of $54,000,000 chargeable to the lack of light and according to census reports the total annual expenditure for street lighting in the United States does not exceed $50,000,000.

The percentage of 17.6 arrived at as the proportion of night accidents which may be attributed to lack of light is undoubtedly an extremely conservative figure, for the streets of the cities covered by the survey were illuminated at night by artificial lighting of varying degrees of effectiveness. So in an individual city where the need for better street lighting is especially evident, night accidents chargeable to lack of light may run as high as 50 per cent.

Among manufacturers it is realized that great savings in the cost of production are brought about by a double-shift which spreads the overhead or fixed charges over 24 hours as against 8 or 12 hours. This practice may be followed with equal economies by applying the double-shift to trucking which, according to reports, has in some cases reduced trucking costs almost one-half, due to the increased utilization of equipment and terminal facilities. This night use of streets can be fully developed only by providing improved street lighting. The double utilization of crowded thoroughfares is advocated not only because of its economy from the operator's point of view, but to relieve day time congestion and to postpone the time when expensive duplicate thoroughfare construction will be required by the increasing volume of traffic.

In driving at night, whether it be a truck, passenger bus, or private car, the driver's vision depends upon the fairly constant illumination from the street lights, his own headlights, and the spasmodic, violent influence of approaching headlights. Excepting grade crossings, the greatest danger to automobile drivers is from glaring headlights and with the growth in automobile traffic it is evident that some solution of the headlight problem must be brought about. Apparently there are only two really effective solutions, namely:

1. The establishment of one way streets and interurban or trunk highways.
2. The lighting of trunk highways so that with dimmed headlights cars may be operated with safety and in comfort at the customary cross country speeds.

Efficient highway lighting fixtures have been developed and their use is being advocated by the leading manufacturers of street lighting equipment, and is sponsored by the Illuminating Engineering Society after considerable study and experimenting.

The cost of lighting a highway usually does not exceed five per cent of the cost of duplicating the highway in order to provide for one way traffic, so it is obvious that the second method is more economical than the first.

Many states have put into effect very definite regulations requiring the use of improved headlight lenses, governing their adjustment and various other details. Some have employed Illuminating Engineers and maintained a substantial force of traffic officers especially trained for competency in enforcing headlight legislation, but the most conscientious and persistent supervision has met with very little and unstable success. The solution lies in applying sufficient illumination to our main highways so that drivers will not need their headlights except as markers to define the width of the car or the limits of the area to be avoided in passing, and on city streets to make the approach of automobiles readily apparent to the pedestrian.

The precautions taken to protect the motoring public by posting all sharp curves, narrow bridges, steep grades and the like may be made to serve their full usefulness by proper highway lighting. At present this protection does not extend adequately beyond the hours of daylight.

Trucks as a rule operate at fairly low speed and at slow speeds headlights often afford little illumination so the driver is likely to strike obstructions or holes and do damage to both truck and highway. Many a load has been delayed for hours and sometimes for days because the driver misjudged the edge of the road bed and sank into soft ground. In addition to disrupting schedules and lowering the equipment utilization factor the road is injured when heavy loads ride on the very edge of the road bed.

The cost of good highway lighting is justified by these considerations alone and apart from thoughts of comfort and fear of holdups.

The foregoing paper by Mr. Stahl was presented at the annual convention of the Allied Motor Commerce (of Indiana) at Indianapolis, April 30, 1923.

CONSTRUCTION AND OPERATION OF WARREN, OHIO, WATER PURIFICATION PLANT

By S. N. Vance, Resident Engineer for Alexander Potter, Consulting Engineer, 50 Church St., New York City, and P. J. O'Connor, Superintendent of Filtration, Warren, Ohio.

The water works of Warren, Ohio, were privately owned. The city of Warren was no exception to the rule existing during the last of the war-period and the years succeeding it, when private companies refused or were financially unable to extend or enlarge their systems to keep pace with the growth of the cities.

In 1920 Warren, therefore, was faced with the necessity of purchasing its water plant or standing for an increase in rates, two or three times greater than those then obtaining.

The city retained the services of Alexander Potter, Consulting Engineer, to investigate the entire water works matter, including the question of ultimate source of supply for a greater city and an appraisal of the existing plant of the water works company. Later Mr. Potter was named to represent the city on a two member Board of Arbitration, which fixed the value of the plant at $687,500, which amount was accepted by both the company and the city.

After the award was agreed upon but before the city took possession of the plant, plans were prepared for the rehabilitation of the water works system, the construction of an adequate filter plant and a service reservoir to the east of the city to be constructed of reinforced concrete and built wholly above the surface of the ground.

In taking possession of the plant, the construction of a 6,000,000 gal. filter plant was immediately undertaken and contracts let within a month. The plant is located in the city of Warren at Summit street and Mahoning avenue and on the east bank of the Mahoning River.

Old Filter Plants

The original plant, built in 1895, had a capacity of 1,500,000 gals. per 24 hours, and while it was, no doubt, modern at the time of erection, the art of water purification has advanced so rapidly that today a plant of its type is so out of date that we will not devote more space to it.

To meet the demands for more water and to obtain less expensive operation, in 1917 the Trumbull Public Service Company erected a new and more modern mechanical filter plant. This plant was built on the same property but back from the river and consists of four 500,000 gal. units, two storage basins with a total capacity of 90,000 gals, which were under the filters, or tubs as they are called, and two settling or coagulating basins, each with a capacity of 250,000 gals. This plant was constructed of reinforced concrete with the superstructure of brick.

Unfortunately the plant was not so designed that it could be added to sufficiently to become a big plant; therefore, it could not provide but for a short time for the increasing demand for water, for both industrial and commercial uses. The size of the units were entirely too small, as a big plant with small units is very expensive to operate. In addition to this big handicap, the back half of each unit was covered with a low flat roof, which touched the water. The ice formation was therefore bad and in a very awkward place to remove. The coagulating basins were not covered and the ice formation caused the wall to crack.

The chemical feed devices as well as all of the valves were manually controlled, that is except the valves on the rate of flow controllers which were hydraulically operated.

As stated above, the plant could not meet the rapidly increasing demands, though an extreme effort was made and the plant taxed beyond what should be expected of any mechanical plant. It was often operated at 100 per cent over its normal rating.

The new plant was built of reinforced concrete with the superstructures of tapestry brick with stone trimmings, the inside of the filter building being of a buff pressed brick conforming with the old filter building. The plant consists of a mixing chamber with a chemical feed house and a storage room above, a coagulating basin and six 1,000,000 gals. per day filter units, with storage basins beneath the filter units. The plant is of the mechanical gravity type.

Mixing Chamber

The mixing chamber is 17x35½ ft. and 23 ft. deep, inside dimensions, and is divided into eight equal size compartments, each having an inverted pyramid bottom in which there is a sludge drain valve, the valves being operated by long extension stems from the floor above. Each of the eight compartments are divided in half by means of a baffle wall which extends from above the water line down to within 3 ft. of the sludge valves. A two-story superstructure, 17x17 ft. of brick with reinforced concrete floors is built over one-half of the mixing chamber. The top story of this building is used for the storage of the chemicals which are elevated to it by means of an electric hoist.

The first floor is used for chemical feed machines and their appurtenances for automatic proportionate feeding, gauges for the meters indicating the amount of raw water pumped, desk, lockers, etc. Provisions were made for duplicating the mixing chamber for future extensions.

Coagulating Basins

The coagulating basin is 90 by 51 ft. and 19 ft. deep, inside dimensions, and has no cover but a walk 3 ft. 9 ins. wide was placed on top of and around the outer walls and from this walk a baffle, constructed of plaster on metal laths, was suspended, extending 3 ft. down into the water, the idea being that only a thin ice would form under the walk and against the walls and thereby prevent the cracking of the outside walls. Soon after the plant was put into operation there was a cold snap, about 10 degs. below zero, and while 13 ins. of ice formed on the basin, under the walks it was only 1½ ins. in thickness.

A distribution trough extends across the inlet end of the basin. Into this trough the treated water is discharged. The top outer edge of the trough is 9 ins. below the normal water line, thereby forming a weir. Twelve inches from the trough is a baffle extending from 3 ins. above the normal water line to 3 ft. below; therefore, the water entering the basin must flow over the weir and under the baffle, which gives it a downward motion. About 35 ft. from the influent end of the basin is a cross wall extending up

to within 9 ins. of the normal water line and a weir is formed of the top. This wall is perforated, having 2 in. openings, 12 ins. on center in both directions, the first row of holes being 6 ft. from the bottom of the basin. Six inches from this wall and supported from it by brackets is a baffle wall extending 3 ins. above the normal water line and 18 ins. below. This baffle, as the one just described, causes the water to take a downward motion. The part of the basin between the influent trough and the cross wall has a flat bottom, in which there is embedded 3 in. acid proof tile laterals, spaced 2 ft. apart and each separate tile is 2 ft. long. with a ½ in. orifice in the center. This makes a strainer system bottom with ½ in. orifice 2 ft. 3 ins. on center one way and 2 ft. the other. These 3 in. laterals drain into channels, which in turn drain into 3 cast iron underdrains. The underdrains are 8 ins. and there is a quick opening gate valve on each line, these valves being located in a manhole just outside the basin.

It is found in practice that at least 60 per cent of the settling takes place in the first third of the tank. With an underdrain system such as described, constructed under the first third of the tank, the period between emptying the tank for cleaning can be extended for six or eight months by operating the quick opening valves daily to remove the accumulated settlement before it has an opportunity to compact and solidify.

At the effluent end of the basin there is another cross wall similar to the one above described. This wall extends up to within 2½ ft. of the normal water line, and the first row of 2 in. openings is up 10 ft. from the bottom of the basin. The wall is only 2 ft. 2 ins. from the end of the basin, and thus forms a small effluent chamber. The bottom of the basin between the center cross wall and the effluent chamber is the usual bottom with two 12 in. sludge valve drains. These valves are operated from the walk on top of the wall, the extension stem being on about 45 degs. and working through a universal joint. Provisions were made for duplicating the basin for future extensions.

Filters

The filter units or tubs are 19½ ft. by 20 ft., and 8 ft., 9 ins. deep. There is a pipe gallery in the center with 3 filters on each side, the normal rate of each being 1,000,000 gals. per 24 hours. The tubs, piping, etc., are arranged so that additional units may be added at a minimum cost.

Each filter unit has a gutter across the front end and there are three cast iron wash water troughs extending from the gutter to the back end of the filter, the weir or top of the trough being 24 ins. above the sand bed. The strainer system consists of 2-in. cast-iron laterals spaced 6-ins. on center and having 7/32 in. orifices in pairs spaced 4½ ins. on center. These orifices are on the underside of the laterals. The laterals discharge into 2 cast-iron manifolds, each having an area of 50 sq. ins., which discharge into the clear well beneath the filters.

The gravel which was placed on top of the laterals is in 6 layers and was very carefully screened and placed to come within the specifications, which were:

1st layer, 1½ to 2½-ins., 5 ins. thick.
2nd layer, 1 to 1½-ins., 4 ins. thick.
3rd layer, ½ to 1 -in., 3 ins. thick.
4th layer, ¼ to ½-in., 2 ins. thick.
5th layer, ⅛ to ¼-in., 2 ins. thick.
6th layer, 10-mesh to ⅛-in., 2 ins. thick.
Making a total thickness of 18 ins.

The sand was specially selected so that it would also meet the requirements of the specifications, which were that the effiective size should be 0.35 to 0.45 mm. and a uniformity coefficient of not more than 1.70 mm. After the plant had been in operation for about a week, samples were taken from various parts of each bed and through the entire thickness and tested. The results of the test were an effective size of 0.39 mm. and uniformity coefficient of 1.62 mm.

The pipe gallery is designed with the main piping at the ceiling and in the center; from these the branches of the following sizes were taken for the individual units: 12 in. influent, 10 in. effluent, 14 in. wash, 6 in. rewash, and 16 in. sewer.

A 10 in. venturi type rate controller is placed in the effluent line from each unit. This controls the amount of water filtered. There is a large flume in the center of the pipe gallery which receives the discharge when the beds are washed, this flume being connected with a sewer which discharges into the river. The top of the flume is about 2½ ft. above the floor of the gallery and serves as a walk.

The operating platform is the floor above the pipe gallery. This floor is 2 ft. below the tops of the filters, thereby giving what is known as sunken platforms. There is no operating reason for this but as an architectural effect it is much more pleasing than to have the floor

at the top of the tubs. On the operating floor there is a marble operating table for each unit. Mounted on the table in one metal case is an indicating loss of head gage and an indicating and recording rate of flow gage. There is also on each table an operating handle, with an indicating device for controlling the valves, all of which are hydraulically operated. The small piping to the cylinders of the hydraulic valves is so arranged that the pressure may be taken from either the standpipe or the discharge from the pumps. The necessity of this is, that should the standpipe be empty for cleaning, painting or repairs, the valves could still be operated. For convenience an electric light was placed on each table.

At one end of the operating platform there is a 12 in. gage, connected to the wash water line of each separate unit, which registers the pounds pressure at which the filter bed is being washed. It is an easy matter therefore to get the desired rate which is 2-ft. vertical rise per minute over the sand area, which is equivalent to 15 gals. per sq. ft. per minute.

The average loss of head at which the beds are washed is 8½ ft. and they are washed for about 3 minutes. The filters are washed from the standpipe which is located just a few feet from the filter building. The standpipe has a capacity of 390,000 gals. and is at all times kept full, which gives a static head of 60 lbs. The wash water line is connected to the discharge of the pumps as well as to the standpipe. This enables the beds to be washed in case, for any reason, the standpipe is empty.

Since the water storage supply of the old plant was sufficient to fight a normal fire for only about 8 or 9 minutes, it was necessary that the new plant be erected and the old connected to it with the minimum amount of time that the filters be closed down. Due to a very careful design along these lines, the new plant was erected and the old connected up without once closing down the filters. The raw water pumps, however, were closed down several times in changing over the piping, but at no time for more than an hour. Sunday mornings, just about daylight, is the minimum rate of filtration for the week; therefore, when it is necessary to close down the pumps, this was the time selected.

Raw Water Supply

The water supply is taken from the Mahoning River. There is a dam constructed of reinforced concrete extending across the river. As a part of the dam and near the east bank is the intake chamber, the front and top of which is of gridiron construction, being made up of heavy iron bars spaced 2 ins. apart. These bars withstand the heavy knocks of large logs or other floating bodies that from time to time come down the stream. Inside the intake chamber there are two sets of screens which are removable and easily kept clean.

Located in the old pump house are three low lift single stage pumps, two with a capacity of 2,000 and one of 3,000 gals. per minute. These pump the raw water from the river to the mixing chamber. All the pumps are centrifugal and electrically driven. The water is delivered to the pumps through a 20 in. suction line and discharges into a 20 in. header. The discharge line is increased from 20 to 24 ins. just outside the pump house to allow for additional pumps for future extensions. Between the pumps and the mixing chamber there is a 24 in. check valve and a 24 in. by 14 in. venturi tube, this tube being connected to a Simplex indicating and recording gage which is located on the first floor of the chemical feed house.

The raw water piping is so designed by reversing the flow in some of the piping, that in case of emergency such as repairs to the check valve or venturi tube, the plant could be operated.

Chemical Feed

The alum and lime which are used in the treatment of the water are fed into the mixing chamber by means of two dry feed machines, which were built by the Pittsburgh Filter and Engineering Co. These machines are located on the first floor of the chemical feed house, each having a large storage hopper into which the chemicals are fed from the floor above. They are operated automatically and fed proportionately to the amount of water pumped. The automatic arrangement consists of diaphragms, orifices and piping and is connected to the venturi tube in the raw water line. The machines are driven by water motors, the same water that operates the motors is used to dissolve and wash the chemicals down into the mixing chambers. The lime is fed into the mixing chamber at the point where the raw water enters and is mixed for a short distance, then the alum is added and the two are mixed by passing over and under the baffles. The time of retention at the normal rate of 8,000,000 gals. per day is about 19½ minutes.

An emergency feed line was provided so that should repairs be necessary to any part of the raw water line or the basin, chemicals can be added directly to the pipe line. In the old plant the chemicals were fed only into the raw water line and both alum and lime added at one point.

Operation of Plant

The water is taken by gravity from the mixing chamber to the coagulating basins, leaving the mixing chamber in a 20 in. pipe. It is delivered into the distribution trough of the new basin by means of two 16 in. pipes. In the old basins new distribution troughs were built of wood and the water is delivered into each of these troughs by means of two 12 in. pipes. In all cases the delivery was made in two places to help in the distribution of the treated water.

In the new basin the water passes over the weir of the trough and under the baffle as above described then takes a slow travel towards the effluent end. About 60 per cent of the mud and bacteria are deposited in the first compartment of the basin which has the strainer bottom. The theory of the strainer bottom is that as a large part of the sludge is settled over this compartment, that by opening the 8 in. quick opening valves each day for a very short while the basin would be kept clean. The operating of the quick opening valves depends entirely on the amount of chemicals and that in turn depends on the quality of the water. While it is advisable to open them each day, due to existing conditions at the present time, they are opened every second day and are allowed to run until the water is clear which is about 3 minutes. The time of coagulation at the normal rate of 8,000,000 gals. per day is 3½ hours.

The water is taken by gravity from the effluent chamber of each basin by means of two 16 in. pipes. These are increased as they are connected together and finally enter the pipe gallery as a 30 in. pipe. The piping is so designed that the filters may be supplied from any or all of the basins, thus any basin may be by-passed to allow time for the basin to be washed. The piping is also arranged so that any one or all of the filters may be operated at any one time. This is true of both the old and new units. As stated above, the rate of filtration of any unit can be controlled.

The new clear wells were so designed and connected up with the old ones that there is in reality two clear wells. They are connected by means of a 20 in. pipe line in which there is a gate valve. Normally, this valve is open and the line serves as an equalizer, but by closing the valve either side can be by-passed and thus allow time for cleaning or repairs, should any be necessary.

Liquid chlorine is fed into each of the clear wells at a point about 14 ft. from the suction of the pumps. This point was chosen for feeding the chlorine because of the peculiar design of the old clear wells. They have a cross partition with an opening about 4 ft. square in it; therefore, all the water must pass through these openings at which point the chlorine is fed.

The high service pumps consist of two single stage and one double single-stage pump; all are centrifugal and are electrically driven. The piping is so arranged that they can be made to work in tandem, to obtain higher pressure for fires. The water may be pumped to the standpipe and be delivered from there to the city mains or it may be pumped directly into the mains, thereby by-passing the standpipe.

Laboratory

The laboratory is one of the very important points in the operation. Since the laboratory which was previously used was too small, it was necessary to build a larger one so that additional equipment could be installed. The laboratory, which is 12 ft. wide and 24 ft. long is located on the second story of the pump-house, which was formerly used as a storage for chemicals. There are two chemical tables, each 15 ft. long and 3 ft. wide, located in the laboratory. The table tops are finished in ebony asbestos wood. Underneath these tables and set back 6 ins., there are cabinets which are used for general storage. Above one of the chemical tables a cabinet was built; this cabinet has glass panel doors and is used for storage of chemicals for laboratory use. At one end of the chemical table there is a hood constructed of transite asbestos wood; the hood has a sliding door in which there are two glass panels. The laboratory is equipped with two Mar-Sla stone sinks and also has all of the necessary equipment to control the operation of the plant. A space of about 6 by 9 ft. in one corner of the laboratory is used for an office.

As to the work done in the laboratory, tests are made on the water taken at various points throughout the entire process; this is done that the plant may be operated at the highest possible efficiency. Each day tests are made for the following: Temperature, turbidity, alkalinity,

color, hardness, dissolved iron, total bacteria, colon bacillus communis, microscopical examinations and phenol. The alkalinity tests are made every hour, or more often if the condition of the water is bad or changeable. The plant is operated 24 hours per day.

There are three filter operators and also three assistant operators who work 8 hour shifts. Each man has one day off every week so that necessitates an extra operator who alternates shifts every other day in order to give the operators and assistants their day off. In addition to these seven men there is an extra man who makes repairs around the plant and is capable to act as operator or assistant in case any man is off on account of sickness or other things that might require an operator or assistant to be away.

In connection with the building of the new plant, the old original filter building, which was of no value except as junk, was removed and the space back-filled. The old pump house was renovated in general and a concrete floor built in it for the storage of chemicals, which is of such size as to allow the storage of a car load. This old building contains the boilers for the heating system, coal bins, the low lift pumps, the water meter testing apparatus, repair shop and general storage space.

In back-filling the old filter building, two of the old basins were maintained, one for a future screen chamber and the other for a manhole, containing the 20 in. check valve on the raw water line. The outer or river front wall was maintained as a retaining wall, and from this wall to the dam across the river a new reinforced concrete retaining wall was built. This makes a retaining wall 20 ft. above the normal water line of the river for the entire water front of the property.

The construction work was done by Mapes and Erway, General Contractors of Warren, Ohio. The filter equipment was installed by the Norwood Engineering Company, Florence, Mass., with Mr. James F. Torpey, Filter Engineer, as their representative on construction.

The water system in Warren is modern and the results being obtained are excellent. There are two very weak points in the system; one is the storage of filtered water, the other is the need of more city mains. A design has been made for a 6,000,000 gal. covered service reservoir to be built on Bolin Hill and also for the distribution mains over the entire city. The mains that are now being laid from time to time are in accordance with the above design. The need of the Bolin Hill Reservoir is appreciated by a great many, probably more especially by the Fire Chief than any other, and it is hoped that before a great while the construction work will start.

Cost of Filter Plant

The cost of the new filtration plant was as follows:

Mixing chamber, with chemcal feed house and storage room above	$ 18,579.02
Settling basin	35,254.64
Filter building complete, including clear wells, pipe gallery operating floor, filter tubs and the brick superstructure	40,324.71
Outside piping, including the venturi meters, making the connections from the old to the new piping, and relaying old piping	25,211.94
Removing and back-filling the old filter building, back-filling the low part of the property and back of the retaining wall. Repairs to the old pump house, walks, etc.	11,457.59
Chemical feed machines	2,950.00
Filter equipment	57,547.56
Retaining wall	8,184.00
Renovating old settling basins	1,761.11
Total cost	$201,270.57

REASONABLE INTERPRETATION OF STATE HIGHWAY SPECIFICATIONS IN NORTH CAROLINA

By C. N. Conner, Assistant Engineer, North Carolina State Highway Commission, Raleigh, N. C.

In order to secure a reasonable and rational interpretation of specifications the contract must be clear and definite, the engineers and contractors must be unprejudiced, intelligent and fair-minded; while the highway commission, itself, must have confidence in its engineers, and demand the respect of its contractors.

The commission should take care of policies and agreements, the engineer with design and supervision of survey and construction, the contractor should take care of the actual construction as called for in his contract.

All of this sounds very easy, but when

the personal equation enters in, trouble may or may not result.

Selfish, personal and opinionated decisions are usually disastrous. Any point in question should always be decided on its own merits with the "self" entirely eliminated.

There is often an honest difference of opinion, but if possible the specification should have but one interpretation. A thorough knowledge of the work itself on the part of the engineer and contractor will avoid many misunderstandings.

The old so-called "blanket clause" is becoming less and less popular; it means nothing or anything and is therefore worse than useless.

Contractors sometimes haye said, when they sign a contract, that they are signing away everything but their wife and children; what can we engineers as interpreters of specifications say to this?

To the engineers' discredit, it can be said that contractors have been broken by unfair and unintelligent decisions.

Such things as this result in the contractor bidding on inspection and engineering instead of on the performance of the work itself, a condition which must and can be avoided by maintaining an organized engineering force which has definite specification, unselfish motives, and an average degree of intelligence.

It is a mistake for engineers, in North Carolina, for example, to copy verbatim, the specifications of another state or even the specifications of the Bureau of Public Roads. Conditions are not the same in all parts of the country; frost is a serious consideration in some of the northern states, but is of minor importance in others. A gravel road specification which can easily be met in Maine or Wisconsin will not fit the conditions at all in western North Carolina, where we must use the local material even though it be inferior to Maine and Wisconsin gravel.

Suppose, for example, a contract was let for a gravel surfacing, the engineer had copied a very drastic specification as to quality and grading of the material but had not investigated the local material, or at least, had not realized that it could not pass his specification; the contractor finishes his grading and starts using the local gravel for surfacing; the inspector finds that the gravel does not meet the requirements and that none can be found locally which does. What then? Who is to blame?

If the contractor is obliged to ship in material he will "go broke."

It is plainly necessary to make a reasonable interpretation of the specifications or to draw up a subsequent agreement permitting the use of the local material.

It is not difficult to draw up a specification for absolutely the best construction, but it does require considerable forethought to adapt the specification to local conditions, especially when good materials are scarce, local conditions vary by a wide margin, and economy must be exercised.

For these reasons North Carolina is building practically every type of road and is adopting that type which will best utilize local materials, serve traffic conditions, and maintain healthy competition in bidding.

On nearly every job of any magnitude the contractor raises the question as to whether or not he should perform a certain piece of work. To settle this the engineer must be familiar with his specifications (whether they be good or bad). The work, however, must be done. If it is within the specifications it should be paid for at the contract unit price; if not, a price should be agreed upon or the work paid for on a cost plus basis.

The practice of paying for extra work by increasing the quantities on some other item, such as throwing it into excavation or borrow, is not good business and should be avoided.

The phrase "with written permission of the engineer" is important to the engineer, as well as the contractor; it is nothing more or less than good business practice. It puts in writing the authority for doing work in a manner which may be different from that called for in the specifications.

Some contractors have performed work which they honestly felt was outside the specifications in order to avoid disputes with their engineers; this is not right. There is really no good reason why the contractor or his representative and the engineer or his representative cannot get together and discuss, peaceably, any point on the work. It is done in every other line of business; why not in ours?

The engineer or inspector who attempts to threaten or penalize a contractor by taking unfair advantage of his position, is in serious danger of losing his job. Unfair treatment of a con-

tractor by an engineer or his inspectors should never be countenanced.

Long arguments, however, are dangerout. Oftentimes an unreasonable or impractical requirement will creep into a specification, similar to the following:

"Piles must be cut when the sap is down."

Suppose a job were let in the month of May, must the contractor wait until the following winter before cutting and driving his piling?

Changes in North Carolina Specifications

Some points in connection with the 1923 specifications may be of interest. Under the 1922 specification for drainage ditches the engineer could require the contractor to bring material from a point 1,000 ft. away from the road and place it in embankments. This might prove to be unnecessarily expensive to a contractor if the ditch extended through swampy ground or a heavy thicket.

The question of payment for unavoidable overbreaks and slides has been finally settled by allowing payment for classified excavation.

To supplement the specifications and to make their interpretation uniform and clear, the roadway cross-sections will be given in detail on blue prints for each project.

The stations, on which a given section is to be built, will be listed under that section, so that on each project there will be several sections with a list of stations given under each.

There are several changes in the 1923 specifications which will undoubtedly assist the contractor without injuring the final quality of the work.

Lighter rollers will be allowed on fills with the result that more rolling will be done and the fills will have a longer time to settle before the surfacing is placed.

A minimum weight of two tons will be allowed, but if the weight of roller is less than three tons it must be made up of separate rings 4 to 8 ins. in width, which vary in diameter from 6 to 8 ins. They are commonly called embankment rollers and have been satisfactorily used on reservoir and levee work. Lighter rollers, five to ten tons, will be allowed on the subgrade for hard-surface work.

Placing fills in layers is still required, but each layer may be placed in two horizontal sections, provided the next layer above "breaks joint" with the one beneath.

The gravel specification has been revised to fit local conditions. The topsoil and artificial sand-clay specification has been separated into two items. The plowing and harrowing has been reduced from seven to three consecutive days and thereafter when the conditions are suitable.

The maximum size stone or gravel for coarse aggregate in concrete roadway and base course has been lowered from 2¾ ins. to 2¼ ins., and tabulated grading requirements have been made. Screenings as a part of the fine aggregate will not be permitted. This will or should result in a more workable concrete, which can be more easily furnished.

Progress on shoulder and ditch work must be kept up to within 4,000 ft. of the last surfacing laid. The shoulders and ditches may be built to the approximate section but not finally finished. This will give plenty of time for the soil to get settled and will prevent the subgrade from becoming soft and endangering the surfacing.

When cuts are widened to take borrow their depth must not be deeper than the adjacent subgrade.

The free haul limit on excavation and borrow will be 1,000 ft. and on topsoil, sand-clay and one course gravel will be 2,000 ft. Overhaul will be paid for at 1½ cts. per cu. yd. station of 100 ft.

Hauling over broken stone base course will be allowed provided it does not result in ruts.

The use of hydrated lime in roadway concrete may be employed up to 10% by volume of the cement. When lime is to be used, written permission from the engineer will be given and the lime furnished by the state f. o. b. siding. The contractor will be paid a fixed price per square yard for hauling and placing.

Separate measurement of materials will be required, as before, the measurement being made in vertical compartments in the batch boxes, when used, or in separate containers outside the batch boxes and then dumped into them. In the case of hand-finishing of concrete roadways, it will be necessary to screed the concrete with the steel screed at least twice; two screeds may be employed.

The sprinkling of concrete must be maintained and the contractors should look well to their pumping equipment, source and quantity of water available. The laying of concrete roadway cannot proceed unless that already laid is be-

ing properly cured. The wetting for curing must be done during daylight.

Joints bars should be dipped or painted with heavy oil instead of tar or asphalt.

In reinforced pavements the steel will be placed 2½ ins. from top surface instead of 2 ins. The maximum width of fabric sheets will be 9 ft. instead of 6 ft.

A tinker tamp will be used to precede the steel screed to secure greater density of concrete around the steel. This will make a total of two tinker tamps and one steel screed for reinforced concrete roadways.

Natural rock asphalt will be laid to a prescribed thickness of 1½ ins. instead of 2 ins. and the concrete base course for this will be 5½ ins. thick instead of 5 ins. The maximum size of stone for penetration macadam will be 2¾ ins. instead of 2½ ins.

Vitrified pipe will be triple strength instead of double. Cast iron pipe may be either smooth or corrugated.

Concrete pipe will be tested for 1,000 lbs. by the three-point bearing method instead of 1,500 lbs. The requirements per mix of concrete and curing are omitted but the pipe must pass the strength and absorption tests.

Every successful engineer as well as any other professional or business man realizes that he must keep his work up to the best current practice; for this reason specifications should be studied and revised annually.

Work and policies must be carefully watched throughout the construction period, and any desirable changes should then be included in the annual revision.

The old saying that we should never abandon a policy or method simply because it is old or change to new methods simply because they are new, applies to construction and specifications. We must know why we do things in order to perform intelligently.

The foregoing article by Mr. Conner is reprinted from the North Carolina Highway Bulletin for March, 1923.

SELECTING ENGINEERS FOR CITY SERVICE IN PHILADELPHIA

By Charles S. Shaughnessy, Chief Examiner, Civil Service Commission, Philadelphia, Pa.

Our treatment of the subject of examinations will be confined to the problems of administration of the Examination Bureau of Philadelphia and how we endeavor to meet them. These problems are common to all services, including the engineering and, therefore, the points discussed will be more or less general. Then there are other human problems that come to us of which we cannot give an account inasmuch as they have to do with a great variety of special and individual conditions. It is one thing to have a civil service law and quite another to carry that law into practical effect so that we shall have honesty and fairness in examinations and complete success in the scope of selection.

The problem of selecting persons for the public service is very difficult and intricate and to the casual observer who reads about civil service in the papers the selection at times may appear to leave much to be desired. It must be borne in mind, however, that the difficulties are not inherent in the employment problem but rather due to the political conditions under which we live. The value of the Merit System does not show up in individual cases but rather reflects itself in the general level of intelligence and morale of the entire service. Being of slow and steady growth, its great and lasting benefit reflects itself in a growing improvement in the service. We say that it does not show up in individual cases because we are all prone to decide things on individual cases rather than through the abstract or impersonal effect.

Those who are close to the civil service problems realize perhaps more than anybody else that there are certain latent possibilities in men that cannot be decided in a civil service examination, nor in any examination. Capabilities of men sometimes are not discovered until these men are given the work and the responsibility. Even their superiors at times do not make such discovery until they have been given a try out and an opportunity to make good on the job. Similarly, there are certain defects in a great number of people which do not appear until they have been put in charge of others. The civil service examination, which is well planned and rated, with due regard to the position to be filled, is the best instrument of human measurement yet devised—but like all instruments operated by human beings, it lays no claim to perfection. The City of Philadelphia has the greatest opportunity of any city in the country to test the truth of this statement. Here we have side by side 17,000 employees under the Merit System and 3,000 in the County Offices.

Some day we hope that a study will be made showing the comparative intelligence and productive capacity of these two groups of people. We feel certain that the results will show decidedly in favor of the Merit System.

The procedure of examinations must follow the mandate of law just as does any instrument of government. We must function in accordance with the powers vested in us by the City Charter and with the facilities given us by our budget. Being a problem in human engineering it is not unlike the way of the engineer in letting contracts by competitive bidding. Where the engineer wishes to measure the quality of any material such as sand, he takes samples from various parts of the bank, then mixes and quarters them so that there may be a resulting sample which is composite and representative. Likewise in civil service we sample a person from various angles, his past achievement, his practical knowledge and his personality.

The Problem of Staff

We have three permanent examiners including the Chief Examiner and three part time examiners. With the great amount of work we have to handle it is obvious that this staff must be augmented in some way or other. We are obliged to call in outsiders, special examiners who give of their time gratuitously, in the line of work for which the examination is held. These special or honorary examiners are continually changing, on every monthly schedule; some are new and some serve occasionally. Conceive, if you will, the problem of establishing and maintaining uniform and equitable standards for examinations for over three hundred different kinds of positions with a continually changing staff. You can readily see the problem that is put before our examiners in instructing new people in the work, for as we all know it is a specialty of its own. To place the matter on an engineering basis, let us assume that you have an important piece of design or construction to do and find that your force is continually changing. This adds to the magnitude of the work, especially if the turn-over is high. This is one of the most serious problems we have in Philadelphia and I am sure every engineer can appreciate it. While special or honorary examiners are important and necessary—in fact they are an essential part of the Merit System—their number is out of proportion to the permanent staff.

Plan and Development of Examinations

Examinations are means to a certain end. They are not regarded as a matter of routine but rather one of growth and development. We are correlating and modifying them at all times in order to make them correspond to the positions to be filled. To this end we confer with departments, inspect the character of the duties, study the various fields of activity which best fit for this line of work and make a complete job analysis. We are then ready to lay down the subjects and weights so that the competitors possessing the required capabilities will come to the front rank. In order to keep the matter up to date and to make improvements from time to time we review the plan periodically and study the results of the last examination. This procedure if consistently followed will show vast improvement in the course of a few years. There are several classes of tests, experience, practical questions, etc., that are judiciously arranged to secure the real order of merit.

Training and Experience

The subject of Training and Experience is a statement of training with a chronology of assignments in private employment. On account of the concealment of identity we are not able to determine the quality of service until the actual ratings are made up. This makes the question of evaluation very difficult. Add to this the tendency of some candidates to exaggerate and you have some idea of the magnitude of the problem. However, an experienced and discerning examiner can select the salient features of a candidate's statement and can separate the "wheat from the chaff" with a surprising degree of completeness and comparative accuracy. That we need other tests to supplement this is shown by the fact that sometimes a candidate with high experience has very little knowledge of the position he is seeking; thus demonstrating that he did not profit as much by his experience as was expected nor as much as his competitors.

The Written Examination

The written examination determines knowledge and intelligence and gives a record in case there is need for review. It must be realized that the formulating of questions based upon duties of positions is a faculty in itself. Laying down questions which can be readily understood and have but one meaning is a very difficult task. To appreciate this one has

only to attend one of our examinations and listen to the questions that are put to the examiners. But the real problem in connection with the written examination is the rating of the questions—picking out the meaning of the candidate, reading between the lines and giving him a fair credit for his effort. Any form of test which involves language is somewhat subject to error on account of the fact that it is difficult to discriminate between facility of expression and knowledge of the subject. Mere verbosity as in ordinary life may pass for intelligence or knowledge. Here again the experienced examiner is able to get to the meat of the matter and evaluate the written word exceptionally well. We feel that, by and large, and taking into consideration the entire examination, even those handicapped by the use of language attain their proper place in order of merit.

The Practical Test

The engineer who is essentially a practical man appreciates the practical demonstration as a test of ability. We endeavor to hold a practical test for all the skilled trades. The last examination we had for Auto Truck Drivers consumed the greater part of two weeks. The carpenters and plumbers examination similarly took a great deal of time. We have been obliged to forego a great number of practical tests which we feel are necessary owing to our inability to conduct them because of lack of force. But we feel this test to be the most accurate of any subject yet used in examinations. It lends itself to comparative evaluation and is a positive instrument of proven worth through a specified task on the job.

The Personal Fitness Test

The object of the personal fitness test is to secure some measure of personality. It is extremely important in some positions, especially those of an administrative character or those having to do with the public. Properly to conduct the personal fitness test requires persons of good common-sense; a keen insight into the human quality; and a judicious and discriminating mind. Standards can be developed under these conditions, which with an examining board of three persons, gives a good comparative measure of the personal equation. We are finding this test an efficient supplement to the other subjects of the examination.

Present-Day Needs

There is unmistakable evidence of the great value of improved methods in civil service examinations in raising the level of intelligence of city employees. Translated into positive action this insures to the taxpayer, and all the people, an increasing measure of real service which means much to government. That the progress already made may be conserved and further accelerated there are three desiderata:

1. A closer mutual interest among the departments and the Civil Service Commission in solving personnel problems. A spirit of cooperation which regards civil service as a constructive agency, aiding each department to fulfill its functions more effectively.
2. All personal service budgets of departments to have titles which shall be descriptive and appropriate to the duties to be performed. Thus a title of a position shall mean a definite duty; and when a requisition is made on the Commission for men to perform such duty there shall be no possibility of misunderstanding.
3. An increase in the Examining staff of the Commission.

The foregoing address was presented by Mr. Shaughnessy before the Society of Municipal Engineers of the City of Philadelphia on January 19, 1923.

COMPARATIVE GASOLINE CONSUMPTION ON DIFFERENT ROAD SURFACES

By A. B. Cutter, City Engineer, Everett, Washington.

Having noticed more or less conflicting reports as to relative tractive resistance of rigid and non-rigid and gravel types of road surface, I arranged during the past winter for the making of exhaustive tests in the State of Washington, which is my home, and the neighboring States of Oregon and California, and believe the result will be of public interest. There being no snow in the Pacific Coast States, the test could be made during the winter months.

Types Tested

Representing the three general types of road surfaces, sections of road were selected for each type as follows:

1. Rigid type—Portland Cement Concrete.

2. Non-rigid type—Warrenite Bitulithic.

3. Gravel or earth.

The rules governing the comparative tests were as follows:

(a) Distance of each test 100 miles continuous operation. This was regarded as a distance sufficient accurately to record the gasoline consumption and produce a fair average. In some previously reported tests the mileages have been so small and so variable as to provide grave danger of inaccuracy.

(b) Make test on road surfaces in good condition but having had at least three years' practical use.

(c) In each State use the same automobile for comparative test of the several types, but different machines were used for comparative tests in some of the states.

(d) Uniform speed of not less than 20 nor more than 30 miles per hour.

(e) Record the date, location, speed and gasoline consumption on exactly 100 miles, as shown by speedometer on the car.

It was not practicable to here make test on gravel road, but exhaustive tests on the other surfaces were as follows:

Washington

Road Surfaces	Bitulithic	Portland Cement Concrete
Date of Test	February 7, 1923	February 8, 1923.
Location	Pierce County, Pacific Highway from DuPont to Country Club	Mountain Road, being extension of Pacific Highway toward Ranier National Park
Air Temperature	40 to 50 deg. F.	40 to 50 deg. F.
Tire Inflation	60 lbs. rear, 55 lbs. front.	60 lbs. rear, 55 lbs. front
Running time 100m.	3 hrs. 45 mins.	3 hrs. 45 mins.
Average speed per hr.	26.7 miles	26.7 miles
Gasoline consumed	[illegible] gallons.	5.5 gallons.
Miles per gal. gasoline	18.2	18.2

Oregon

Road Surfaces	Bitulithic	Portland Cement Concrete	Gravel
Location	Base Line Road Columbia River Highway	Multnomah Hillsboro Road	Multnomah County East of Portland
Date	Jan. 25, 1923	Jan. 30, 1923	Jan. 31, 1923
Weather	cool-moderate wind	cool-moderate wind	cool and fair
Tire Inflation	60 lbs. rear, 55 lbs. front	60 lbs. r., 55 lbs. f.	60 lbs. r., 55 lbs. f.
Running time 100 m.	4 hrs. 35 mins.	4 hrs. 25 mins.	4 hrs. 40 mins.
Average speed per hr.	21.9 miles	22.7 miles	21.4 miles
Gasoline consumed	5.25 gals.	5.5 gals.	7.0 gals.
Miles per gal. gasoline	19.05	18.18	14.28

California

Road Surfaces	Warrenite-Bitulithic	Portland Cement Concrete	Gravel
Location	Tulare County	Tulare County	Fresno-Raisin Rd.
Date	Feb. 3, 1923	Feb. 3, 1923	Feb. 1, 1923
Speed	15 to 20 m. pr. hr.	15 to 20 m. pr. hr.	15 to 20 m. pr. hr.
Weather	Fair	Fair	Fair
Temperature	45 to 75 deg. F.	45 to 75 deg. F.	55 to 70 deg. F.
Gasoline consumption 100 miles	7.1 gals.	7 gals.	7.8 gals.
Miles per gal. gasoline	14.08	14.28	12.95

Conclusions

The above tests show that:

(a) Between Portland Cement Concrete and Warrenite-Bitulithic roads tested under uniform conditions, there is practically no difference in gasoline consumption.

(b) On gravel or macadam roads in good condition, the gasoline consumption is from 10% to 35% greater than on either Warrenite-Bitulithic or Portland Cement Concrete road surfaces.

(c) The tests were made on road suffaces in good condition. Of course the gasoline consumption would be relatively increased if the road surfaces were in bad condition.

(d) Under modern volume of traffic, good roads rapidly pay for themselves in economy of gasoline consumption and the same holds true in economy of tire and other automobile wear and tear. For instance, given a road carrying an average of 2000 vehicles per day or 730,000 vehicles per year, and calculating from the Oregon test above, we find with all the road surfaces in good condition, that:

On Warrenite-Bitulithic and Portland Cement Concrete roads the gasoline consumption is about 730,000 divided by 19 equals 38,400 gals. which at 30c equals $11,520 worth of gasoline, the consumption per mile of road per annum.

On Gravel roads 730,000 divided by 14 equals 52,000 gals. which at 30c equals $15,600 worth of gasoline the consump-

tion per mile of road per annum.

Saving on gasoline above by hard surface roads is 13,600 gals. at 30c equals $4,080 per mile of road per annum.

2. The relative saving in wear and tear on tires and other automobile parts cannot be computed, but it doubtless is fully as great as the gasoline consumption. Add to this the savings in road maintenance cost (to say nothing of wear and tear on nerves of road users) we have an object lesson of the economy of high type roads and of keeping roads in good repair for economic use.

THE DEVELOPMENT OF HIGHWAY TRANSPORTATION

By H. W. Howard, General Motors Truck Co., Pontiac, Mich.

In studying transportation we quickly discover that it influences every phase of our existence. The transportation of goods is an absolutely essential requirement for the family, industrial and commercial life of a civilized people.

Transportation Slow to Develop

As a background, I should like to draw a rapid picture of transportation development. Strange as it may seem, nothing in the world has been so slothful in its development as transportation.

Ninety per cent of all the years that have elapsed since the birth of Christ saw in use the same primitive mediums of transportation that prevailed during His lifetime.

In 1800 years the world had not advanced beyond the point of the man-hauled or the beast-hauled wagon or cart, or the man-propelled or wind-propelled boat.

The Evolution of Trade Carriers

The idea of a boat as a carrier came early in history. The very earliest known human beings fastened logs together and guided them down stream, or even scooped out one side of a fallen tree and made a rough canoe in which they carried their belongings. If they went by land, however, their method for centuries was to shoulder their loads pickaback. If two men were together they learned that the burden could be carried more easily if it were suspended from a pole whose ends were supported on their shoulders. Thus the lever principle was used in many forms of carrying devices. In due time, perhaps as early as 3000 B. C., man learned to make the wheel which served as a burden-bearing device. It was but a short step, then, to the two-wheeled carts and chariots to which the merchants and warriors of ancient Babylon harnessed their oxen or donkeys.

The Horse Supplants the Ox

A thousand years later, or perhaps more, the mountaineers came down into Babylon leading a strange animal which the Babylonians had never seen. This beast proved so amenable to training, so strong and so fleet, that he began to supplant the slower and more cumbersome ox as a beast of burden. Thus the horse first appeared in a civilized community to play the important part he has maintained ever since in the commerce of the world. From that time to this, he has been regarded as the standard by which other units of transportation are judged.

And Finally the Horseless Vehicle

With the advance of civilization and the discovery of such forces as steam and electricity, remote communities became connected with each other by means of steamships and railways, so that trade and commerce grew to tremendous proportions.

For years the horse and wagon supplemented the steamship and railway, but with the advent of the gasoline engine, the horseless wagon made its appearance and has steadily increased in favor for commercial haulage because it has proved to be stronger, faster and more economical than the horse and wagon.

Transportation by motor truck lies entirely within the 20th century. While the railroads have been building since the fifties and have taken over half a century to acquire their present proportions, the first motor truck was built as late as 1900.

I should like to illustrate by figures relating to 1921, just how freight haulage by motor transport compares with that carried by steam railroads, (1922 figures are not yet complete):

Railroads carried 1,642,251,000 tons of freight.

Motor trucks carried 1,430,000,000 tons or 87% as much as the railroads; truly a remarkable showing.

Someone has well said that "the future development of any type of transportation will be governed by the economic value which it will be able to show the communities it serves."

The past few years have witnessed an economic shift greatly favoring Motor Transport. The field for Motor Transport has consistently widened.

Railway officials have readily admitted

that for intra-city movement and for inter-suburban service Motor Transport fills a much needed gap, handling less-than-car-lot business more efficiently and economically.

Mr. Gerrit Fort, Vice-President of the Boston and Main Railroads, has stated, "the motor truck has come to stay. It represents an economic change in transportation conditions which is little short of revolutionary. There is no use in fighting the motor truck. Within their own field the trucks are unbeatable."

We do not think that we can take the place of the steam railway in long distance hauls. We do not think we can move freight as cheaply as the waterways. We concede cheerfully the function of other mediums, but we do insist that our place be equally recognized.

Motor Vehicles Feeders to Railroads

The motor bus, the truck, and the passenger car, have temporarily taken some traffic from the railroads and trolleys, but isn't it true that they have been feeders which helped to increase traffic as a whole? Much produce would never reach the market if it were not for trucks to bring it to the railroad station, while scores of people now travel on trains who seldom left home prior to the general introduction of the automobile.

The truck is daily proving its own case. Its increasing use would not be possible if it were not efficient. Whether the truck be placed at work in the city on short or long hauls or in suburban or inter-city work it will usually show a decided saving over the horse-drawn vehicle. There are cases, of course, where the horse should still be used. This is a question to be decided upon on a dollars and cents basis and should be considered by a competent Transportation Engineer. The cause of some dissatisfaction with trucks in the past has been inefficient operation and cost keeping. I will discuss this point a little farther along.

Looking at the motor truck in a broad way it possesses the following important advantages over horse-drawn equipment:

First: Speed.

Second: Increased Power.

Third: Adaptability to difficult work.

Fourth: Regularity of service.

Fifth: Greater effective delivery range.

Sixth: Publicity value.

I could spend a great deal of time enlarging upon these points but I think that these advantages are familiar to all.

How the Farmer Benefits

It is not the city man or his family which benefits most from the motor truck. The farmer is typical of one who gets the greatest benefits. When joined with good roads, the motor truck: Gives access to the nearby town and thus ends his isolation; it enables his children to go to better schools, (bus lines are now operating that take school children to more than 12,000 schools of a much better type than the one-room school house of old: It gives him more time to work on the farm; the land he buys can be bought for productivity irrespective of whether or not it is near a railroad; it brings supplies of all kinds to his door, including the daily paper and the magazines. It is his connecting link with his market and permits him to move his produce when prices are right.

The truck-using corporations form but an infinitesimal part of those who gain from motor transportation.

Why Shippers Prefer Trucks

We find very generally that, aside from the rates, the reasons why shippers prefer motor trucks include: Own control of the shipment; no boxing; door-to-door delivery; regularity of delivery and operation of plants; saving of time; permit carrying lighter stocks with saving in interest.

The truck may have temporarily taken some traffic from the railroads, but in return it has given them a lot of traffic which otherwise might not have been available. Prominent railroad men ask that the truck take the short haul business, which to them has been unprofitable because of congested terminal facilities.

The truck undoubtedly takes traffic from some short haul railroads. Of the 649 railroads in the short line association, more than two-thirds are listed as having less than 25 miles of track, which, under the new order of things, means that they will have difficulty competing with the motor truck and are, to some extent, an economic waste.

Railroads Using Motor Buses

We find, too, that instead of extending and building branch lines, railroads, trolleys, and even the Chicago "L" road, are making use of motor buses as feeders. President Harding in his last message said: "The motor truck should become a co-ordinate factor in our great distributing system."

Vice-President Lee, of the Pennsylvania, says many bus and truck lines have failed. Undoubtedly many lines were

started over routes where profits were not possible, while many others with good prospects were ruined by mismanagement, operating costs and inefficient operation. And yet hasn't that same thing been true of many of our railroads in past years?

The shipper is interested not alone in railroad or truck transportation, but in complete transportation. He must examine his total costs, not that portion which goes to one carrier. It is the public duty of all agencies of transportation so to co-ordinate their facilities as to give the public the best possible service at the lowest possible cost.

Can Save by Re-organizing L. C. L. Business

From 20 to 25 per cent of the total railroad equipment is absorbed in the carriage of less than 5 per cent of the business and less than 10 per cent of the carriers' earnings comes from this source: less-than-carload freight.

Fifty per cent of the capital investment of the rails is tied up in other than main line facilities. Is it not the duty, then, of the transportation agencies to examine their less-than-carload freight business and to make changes in practice which will cut down their operating expenditure while increasing their net income?

Railroad men generally agree that the short haul field is unprofitable in most cases and belongs properly to the motor truck. The door-delivery service, the terminal and intra-yard use and the service of generating of new business for the rail lines indicate the real sphere of use of the motor truck.

The fields within which complete transportation of goods can be furnished by highway alone or by railway alone are limited. Let me explain that complete transportation covers the moving of the goods all the way from the premises of the shipper to the premises of the consignee.

Trucking Distance 25 to 150 Miles

There are very few industries or residences in the continental United States, which are not connected with each other by highway and it is physically possible to perform complete transportation of goods by highway, between almost any two industries or residences. But such transportation is most economical only when limited to the movement of goods between homes or industries which are within reasonable trucking distance from each other. The determination of such reasonable distance depends on many conditions and a competent truck expert will place it anywhere between 25 and 150 miles. Of course, there are emergencies and peculiar industrial conditions which, in rare cases, make trucking economical over a distance of several hundred miles, but such cases are negligible in the consideration of the whole field of highway transportation.

On the other hand, comparatively few industries and practically no residences are connected with each other by railway. Therefore the field for complete transportation of goods by railway is restricted to the movement of car-load freight between those industries which have direct rail connections.

In view of this situation it is inevitable that there will be an increased common carrier use of the truck. In these cases franchises should be granted and the carriers required to operate on fixed schedules over definite routes. Since any charge against transportation is a charge against the consumer, we do not believe in transportation taxes, but we do not ask that other agencies be taxed and we exempt. All we demand is that there shall be no discrimination in taxes against any unit in completed transportation.

Some people like to say, tax the motor truck operator. He gets the benefit. Did you ever know anyone who drove a motor truck for pleasure? He drives because the consuming public demands the service.

Occasionally we hear a complaint from a railroad official that it is unfair to build roads alongside of railroad tracks because they put highway transportation in direct competition with the railroads, which in turn have to pay part of the cost of construction of the highway. That seems a reasonable basis for a complaint until we begin to analyze the question.

Railroads Paralleled Highways

It should not be overlooked that the railroads were the first to parallel our highways. Later the trolley lines paralleled the railroads, and now public demand requires the improvement of the highway to care for increasing travel.

The highways thus improved are intercity roads over which there is ten times as much passenger travel as truck travel. These car owners are probably the biggest payers of taxes in that vicinity.

A major part of the trucks using it are owned by business men or corporations in that vicinity, who have contributed

heavily in taxes for the building of the highways.

Much of the travel on those highways are with trucks and buses bringing merchandise and people to railroad stations for long haul travel.

Community Requires Intercity Roads

These intercity roads are required by the community. Light feeder roads are built back into the agricultural sections, all leading to the main highways and the big towns where the markets are located. These big towns are naturally connected up by the highways the same as they are by railways. The rail lines undoubtedly lose some traffic, but in the long run their gains far outweigh their losses.

Congress, in its last federal appropriation for highways, provided to some degree for the upkeep of these main traveled lines used by everybody in the state, and even by those out of the state.

I have mentioned the necessity for efficient operation and cost-keeping covering motor truck equipment. Motor trucks are wage earners. They prove the right to consideration in our transportation by the extent of the economy which they effect. Whether to use motor trucks or not must be determined upon a dollars and cents basis.

Bear in mind that the cost of operation per day, of the unit, does not tell the whole story. The work capacity of the unit involved is even more important. That is, how much work will the respective units perform per day? It all must be brought down to a cost per ton mile basis in order to obtain a comparison. Even with the cost per ton mile at hand you will not have the true answer unless you are sure your equipment is being operated efficiently. I will discuss this point a little later.

It is only in recent years that proper attention has been given to the question of securing the real cost of operating delivery equipment. We know fairly well what it costs to operate gasoline trucks, but without question there is still room for improvement in this direction. Without a standard cost system, comparative figures will not mean much. Unless costs are figured on the same basis and in the same manner a comparison of these figures will cause endless confusion and argument. I recommend to you the adoption of a standard set of forms in compiling your delivery costs covering both motor trucks and horses and other delivery equipment. By using a standard method, a comparison of cost figures would mean something and if one member found his cost above the average, he could quickly find out why and endeavor to correct the situation.

The Truck Owners Conference, Inc., have formulated a National Standard truck cost system. Their first effort resulted in such a complicated system that it was not practical in many cases. They have a simplified form, however, which is proving to be very popular and at the same time tells the truck operator what he should know about his operating costs.

Let us consider for a moment the subject of efficient operation of delivery equipment. The amount of work that a truck can perform depends largely upon the efficiency with which it is handled.

I wonder how many truck operators realize the importance of the lost time factor and what it is costing them every day? How many traffic managers in control of trucks have set out to study first hand what is a satisfactory day's work for a truck? How many traffic managers have ridden all day on delivery vehicles, making time studies of the vehicle, the driver and the helper, during the work day?

The question of the lost time factor is worthy of our earnest consideration. The lost time factor usually contributes more toward the operating cost of motor trucks than do the items of depreciation, repairs, gasoline, etc., put together.

In a general way, most progressive truck operators have realized this. They will tell you that "it doesn't pay to have a truck stand around doing nothing," and they seek in probably a halfhearted way to keep their trucks moving.

But if the prime importance of this lost time factor was fully understood by motor truck owners and if it were recognized what enormous savings or earnings could be effected in transportation costs by reducing this factor to the absolute minimum, the demand for motor trucks would be so great as to swamp the manufacturers completely.

How shall we arrive at the lost time factor? The best way is to make a time study of the truck's operation. An analysis of the time during which the truck is not in motion will quickly show why the truck is not earning more money. This unproductive time should then be cut down to the very minimum by endeavoring to improve the loading and unloading conditions as well as eliminating other delays which are made apparent by the time study. This will permit the opera-

tor to arrive at a standard trip time against which the daily record of operation should be checked

As a basis for comparison of trips a standard should be established covering the following items:

1. Minimum loading time.
2. Minimum unloading time.
3. Running time per mile.
4. Average loss of time on account of poor drivers, traffic delays, etc.

Such standards should be established for various lengths of haul. This gives an exact basis for figuring the time required for any length of trip. A definition of a day's work should be conceived by the traffic manager at his office, but determined by studies of actual conditions in the field.

In the short time available for the discussion of such a large and important subject, I could only hope to touch upon a few of the high spots. I will feel well repaid if I have impressed upon you the value of making a real analysis of your transportation problems. The adoption of a standard cost system would be well worth careful consideration. I can summarize my message in two short sentences.

Be sure your delivery costs are accurate. Make sure you are operating your delivery equipment efficiently.

The foregoing paper by Mr. Howard was presented at the Annual Convention of the Allied Motor Commerce (of Ind.) at Indianapolis, April 30, 1923.

SALVAGE AND MAINTENANCE OF MACADAM ROADS IN PENNSYLVANIA

By W. A. Van Duzer, Assistant Maintenance Engineer, Pennsylvania State Highway Department, Harrisburg, Pa.

The development of road construction and the necessity for intensive maintenance is directly attributable to the increased motorization of traffic. The problem now confronting highway engineers, and which has confronted them for the past decade, is to keep pace with this increase.

As an example, motor vehicle registrations in Pennsylvania in 1912, both automobiles and trucks, totaled 58,221. In 1922 there were registered 765,000 automobiles and 66,000 trucks, or a total of 831,000 vehicles.

The funds actually expended in the maintenance of the highway system in 1912 totaled $900,000, while the expenditures in 1922 totaled $8,770,000. That is, in 1912 we had available for maintenance $15.46 for each automobile and truck registered, whereas in 1922, although there was increased travel on the roads and a very great increase in the weight and use of trucks, we had but $10.55 for each vehicle registered. This in face of the fact that our mileage has been increased in the last ten years by 1,520 miles, making a total of 10,320 miles.

The finances available for road construction have of necessity limited the building of durable types of pavement, and therefore road authorities, who have the comfort of the traveling public at heart, are applying modern methods of maintenance to some of the older types of construction, with varying degrees of success.

The Problem

The problem in Pennsylvania has not differed to any extent from that in other states, except that the stone road mileage is greater on account of the large number of toll roads that were included in the original highway system. By legislative enactment, approved May 31, 1911, 8,800 miles of highways in Pennsylvania were taken over for construction and maintenance at the entire cost of the state. Of this 8,800 miles, 521 were toll roads built by various corporations during the past century, and in the main were of the macadam type of construction. The mileage of other macadam roads totaled 2,100.

The majority of the toll roads and a great many of the other roads acquired in 1911 were very narrow, in some instances not over 12 ft. in width. There was a woeful lack of both sub-surface and surface drainage. A comprehensive survey of the condition of the roads was made in 1915 and a definite policy established with regard to a program of resurfacing and reconstruction. It was felt that if the state was to have a connected system of highways a certain amount of resurfacing of the old stone roads should be taken up each year, and the demands of traffic compelled the department to find some methods of resurfacing, in addition to the water-bound macadam or penetration types. It was early shown that our finances would not permit the resurfacing of sufficient mileage with either of these types to give the required results in the desired time. It was, therefore, determined to use the water-bound and bituminous macadam upon the heavier traveled routes,

while the unbound macadam, which will be fully explained later on, is used upon the secondary or less traveled roads.

Organization

In order properly to carry on the maintenance work and to provide for the increase, which would surely develop, a modern organization was established which places the responsibility for the maintenance of these roads upon 15 District Engineers, reporting to the Maintenance Engineer, and 53 Superintendents, working under the direction of the District Engineers. Under the Superintendents are foremen, caretakers, laborers, etc.

Planning

We have always given a great deal of attention to the proper planning and outlining of our maintenance work, which consist chiefly of the reclamation of stone roads. Systematic and thorough surveys of local materials have been made in all parts of the state and tests taken to establish their relative values. When it is impossible to obtain local material, quotations are secured from commercial quarries and the stone is shipped in. Wherever possible mechanical means of unloading material have been adopted.

Traffic Census

A careful and accurate traffic census was early inaugurated, which has been of considerable assistance in determining the type of repairs. It has been our experience that the proper surfacing of a road will create a traffic out of all proportion to the seeming importance of the roadway.

Equipment

At the beginning of the year a thorough study is made of the total amount of work in each district and the necessary equipment required, such as rollers, trucks, etc., after which a schedule is made up for each job, showing the length of time that the equipment will be in operation upon each specific authorization. By this method we have kept our department equipment operating continuously, thereby reducing to a minimum the necessity of renting machinery.

Base Survey

Before the actual operation of water-bound macadam or bituminous macadam resurfacing is taken up, we establish by actual measurements the depth of stone in the existing roadway. In places where water breakers are found they are removed. Test pits are excavated to the bottom of the stone in the center, and measurements are taken on each side for a distance of half the width of the road. These pits are dug every 25 to 50 ft., depending upon the type of the road. After this work is completed the base is widened out, and in places where sufficient foundation is not shown additional stone is added to bring it up to the required depth. Then the road is scarified lightly and reshaped with a road machine. The base is brought to a true cross section and grade by the use of a crown board and steel pins are driven every 10 to 20 ft., depending upon the profile, and a cord stretched along the edge and to the top of the proposed ballast. Berms about 4 ft. in width and from 1 in. to 2 ins. above the line are then built up.

Water-Bound Resurfacing

Our experience has shown that more satisfactory results are obtained by the use of large stone for water-bound macadam resurfacing; that is, stone varying in size from 1½ ins. to 3½ ins. The material is dumped upon the subgrade and forked, thus eliminating the danger of the segregation of the sizes, which is the cause of a great deal of subsequent patching. The stone is built to a crown board and then thoroughly locked with the roller, after which the screenings are applied fanwise with a shovel and rolled until the voids are thoroughly filled. The water is then applied and the road rolled until the mortar is flushed or puddled, and the road is then allowed to set before surface treatment.

The maintenance of the road during the time that it is setting consists principally of sweeping, either by caretakers or lightly by mechanical brooms or horse-drawn sweepers. The sweeping is done for a dual purpose: First, to remove the caked or matted screenings from the edges, which must be done in order that proper penetration of the surface treatment material may be obtained, and, second, to replace these screenings in the center of the highway from which they have been removed by the action of traffic, which will prevent the road from raveling and assist in compacting it. Under especially heavy traffic it is found necessary to add screenings, and during hot, dry weather horse-drawn sprinklers can be used to advantage.

Surface Treatment

Previous to the first application of the bituminous material, which we believe should give the maximum penetration, the screenings must be removed by sweep-

ing so that the voids will show between the ballast to a depth of possibly a quarter of an inch. Material must be applied in two applications with a pressure distributor, the first one to be approximately 0.33 gal. to a square yard, and the second from 0.20 to 0.25 gal., as the road requires. It has been shown in some cases that a third of a gallon applied will penetrate the road from a quarter to five-eighths of an inch, this penetration depending upon the kind and cementing value of the stone. The second application will heal up the spots that are not thoroughly bonded, but will not fill the voids, and leaves the ballast to take the voids with the bituminous material as a binder. Although we do not ordinarily apply chips upon the first treatment, skid chipping is desirable as a safety measure on heavily traveled roads by applying from 5 to 10 lbs. of chips to the square yard.

In order to obtain the best results, our experience has been that three successive treatments should be made; that is, the first year the treatment described above, and providing the road is subjected to extremely heavy traffic, a second treatment is given the same year, and the third the season following.

The second treatment should be a high viscosity bituminous material, the quantity just sufficient properly to fill the voids, and this can only be determined by experience, but in most instances varies from 0.25 to 0.30 of a gal. per square yard.

Hard stone chips, ranging from ¼ in. to 1 in. in size, dustless and free from dirt, should be used as a covering at the rate of from 20 to 30 lbs. per sq. yd., or approximately 1 cu. ft. of stone chips to 1 gal. of bituminous material.

Owing to the large chips used and to assist in compressing them into the bitumen, the treatment should be rolled with either a 5 to 8-ton tandem or a 10-ton macadam roller, as soon as the chipping is completed, but if a material that does not dry rapidly is used, we believe that equally good results can be obtained if the road is rolled from 24 to 36 hours after the bituminous application.

The third treatment may be either a high viscosity coal tar, water gas tar or asphalt, or, as an alternative, a hot material. We apply from 0.15 to 0.25 gal. per sq. yd. of the hot material, which requires from 30 to 40 lbs. of chips. This treatment must be watched carefully, as the road will bleed after being thrown open to travel, and if not given proper care will pick up under tire wagon traffic. I have known instances where a treatment of this character applied late in the fall required re-chipping at the beginning of the hot weather in the spring. We have found that stone chips for covering give the best results.

Bituminous Macadam Resurfacing

The reclamation of the old base for bituminous macadam resurfacing is taken up practically in the same manner as the water-bound. After the road has been brought to a true cross section, approximately 3 ins. of stone, varying in size from 1½ to 2¾ ins., is spread to a depth of 3 ins. This is locked by rollers and then the bituminous material is applied at the rate of 1¾ to 2 gals. per sq. yd., depending upon the kind of material used. Stone is uniformly spread, varying in size from ⅝ to 1 in., which is properly rolled and a seal coat of from ½ to ¾ gal. per sq. yd. of bitumen is then applied and chips of approximately ½ in. are spread over the surface. The road is then rolled until it is properly bonded.

In some instances we have prepared a base, employing practically the methods of water-bound macadam construction, even to the extent of an application of bituminous surface treatment of a material giving the maximum penetration; placing on the base so prepared a hot mix of either sheet asphalt or asphaltic concrete.

Unbound Macadam

The unbound macadam, which we have used with good results on secondary roads, is considerably cheaper than the water-bound construction, and for one or two seasons gives very satisfactory results. The method usually employed in the construction of unbound macadam is to scarify the old road surface, shaping it up with the road machine and rolling until a firm foundation has been obtained. Stone, clear of dust, varying in size from ½ in. to 1½ ins., is piled along the side of the road. Just ahead of the distributor the stone is spread uniformly to a depth of approximately 2 ins. Where possible traffic is kept off, or at least confined to one side. Then apply from 1/3 to 2/3 gal. per sq. yd. of bituminous material, with the proper penetration, or a larger amount where two applications are made, which is governed by the depth of the loose stone and is varied accordingly. The material is allowed to dry for from one to three days and then rolled, and providing

a larger amount is required properly to seal the road, apply 0.20 gal. per sq. yd. Under traffic it becomes comparatively smooth and little difficulty is experinced through rutting.

Maintenance System

We know of no type of construction that requires more uniform and continous maintenance than stone roads. The advantage of thoroughly experienced workmen is unquestionable; care must be exercised in picking the organization and seeing that proper instructions are issued covering each phase of the work.

There are two general systems in vogue in the maintenance of these roads, both of which have their advantages. First, the caretakers or patrolmen, the other the patrol crew or gang. The first, of course, comes closer to the ideal if properly controlled. This plan arranges the road mileage in sections three to five miles in length, each section in charge of a patrolman provided with the necessary tools, materials, etc., whose duty it is to take care of the small repairs and emergency work and with authority, when necessity demands it, to hire additional men, teams, etc., upon instructions from his immediate superior. These caretakers keep the surface patched, all depressions filled, see that the side gutters and cross drains are kept open, and paint slight surface depressions and sprinkle with chips tamped in place. Larger depressions are filled with large stone and then topped with patching tar and chips, the mix varying in proportion of 1 to 12 or 1 to 15, depending to some extent upon the weather. The patrolmen or caretakers file daily report cards, giving the character and extent of their work, hours engaged and nature of work performed.

The patrol gang is an organization of picked men, provided with tools, material, etc., to maintain various lengths of road mileage. It is probably more economical than the caretaker system, the men being well trained for each class of repair work. The difficulty experienced in this kind of maintenance, however, is that it is impossible for a force of this character to give each section the required attention at the proper time, especially in emergencases. The particular advantage of the gang system is an insurance against shortage of labor, especially on those sections of road lying in sparsely populated districts. The control can be taken care of by operation reports.

The success of stone road maintenance depends upon organization, equipment and material, a thorough knowledge of conditions and a desire, from the executives to the humblest workmen, to give real road service.

The foregoing paper was presented at the recent annual meeting of the American Road Builders' Association.

DEVELOPMENTS IN CONCRETE PAVEMENT DESIGN IN IOWA COUNTIES

By Raymond Zack, District Engineer, Iowa State Highway Commission, M. B. A. Bldg., Mason City, Iowa.

In discussing a topic of this character I must perforce confine myself solely to concrete paving, because my paving experience has been largely limited to that type alone and for the same reason this discussion must be restricted to county highway paving. A discussion of city types is a large subject in itself and should be handled by men who have specialized in that class of work.

Every succeeding year since the first concrete pavement was laid in Iowa has seen changes in the design, and in the methods of construction. These changes are due to two main reasons: First, we have a greatly increased amount of information on the requisites of good paving because we have observed the behavior under traffic of pavement already laid, these observations being supplemented by extensive field and laboratory tests in connection therewith, and second, these changes have been brought about to a large extent by the rapid change in the character and volume of traffic that these pavements are called upon to bear. The requirements of the traffic of today were not even anticipated ten years ago, nor can one predict today what the traffic of tomorrow will require.

Oldest Concrete County Pavement in Iowa

If one were to drive from Mason City west over primary road No. 19, also known as the old North Iowa Pike, to the west line of the adjoining Hancock County, a distance of 40 miles, one would drive over what is the oldest piece of concrete county highway paving in North Iowa and probably the oldest in all Iowa; and one would also drive over a stretch completed in the early part of last October representing the latest type both in design and construction.

The oldest pavement in the stretch just spoken of is on the second mile out of Mason City. This mile was laid in 1913

by county day labor crews at a cost of $10,500, or very nearly $1 a sq. yard. This was paid for from county funds and subscriptions. The pavement is 16 ft. wide and will average 6 ins. thick, with no reinforcing of any kind. The crown on this piece is 1¼ in. The pavement was laid on a loose, fluffy black soil which became very mucky when wet. No tests were run on cement or the sand and gravel. Unwashed material was used. The sand came from a pit on Willow Creek and contained a heavy percentage of red clay. Since then culverts have been built near this pit and material was hauled from Mason City, because the local deposit is unfit for such use. The coarse aggregate consisted of soft limestone, strippings from the local cement plant, and of unwashed gravel abounding in shale and lumps of clay. The material was dumped on the subgrade and shoveled into wheelbarrows and hauled to the mixer. Two inch wooden forms were used and the riding qualities of the surface are about as poor as the concrete itself.

This pavement has been in continuous service since laid. There are numerous transverse and longtitudinal cracks, which are, of course, kept filled with tar. In the last two summers several holes developed due to a raveling of the concrete itself, two on the west end of the mile near the center of the pavement. These are filled with tar and gravel and cause no more trouble. One hole raveled out near the edge and a little later this broke through breaking out a triangular piece about 18 ins. on a side. Another such piece broke out this last summer right over an old wooden 1x1 ft. box culvert, which had been left in and is now decayed. The action of the tires is causing some wear on this surface, but by taking care of the places that ravel this pavement will serve for a good many more years and after it is unsatisfactory as a pavement it will be worth the original investment as a base for some type of resurfacing.

In 1915 the first mile out of Mason City was paved; this lies just between the city limits and the mile just discussed. This also is 16 ft. wide and is 7 ins. thick at center and 6 ins. at the edge. Improvements in the quality of concrete over the first mile are very noticeable. This job was laid by contract at $1.37½ per sq. yd. It is of two course construction. A base course 4 ins. at the edge and 5 ins. at the center, of good clean sand and limestone in proportion of 1:2:4, was laid and immediately after this was deposited a 2 in. top course was laid using granite chips of ⅝-in. maximum size and a 1 to 2 proportion. The 16 ft. width and the 1¼ in. crown were maintained the same as on the previous mile, neither was it thought necessary at this time to use reinforcing, but there was an increase of 1 in. at the center in thickness. It was also decided that expansion joints should be provided. An asphalt filled joint was placed every 36 ft. This, it was thought, would prevent any additional transverse cracks. This was, however, not the case for today fully 75 per cent of these 36 ft. sections have a full width transverse crack. So that in addition to the cracks provided in the construction, there are now transverse cracks betwen these joints as well.

Beveled Edge Abandoned

Another feature on this mile was the beveling of the edge of the paving. The upper half of the paving was beveled off to approximately 45 degs. It was thought that vehicles getting off the paving onto the soft shoulder could more easily get back on again, and that it would prevent spalling of the top edge. This beveling, however, did not prove satisfactory and was not tried again.

This mile after seven seasons of service is in good condition and is showing no evidence of any failures whatever. There are, however, more transverse and longitudinal cracks than there would have been, had reinforcing been used. There is no surface wear at all noticeable and it shows very plainly what the proper selection of materials will do toward the quality of the concrete.

Beginning at the west end of the old original mile and extending thence west to the east corporation limits of Clear Lake lies Federal Aid Project No. 1. This pavement is four miles in length and was started in October, 1917, and completed the following year.

Attempt to Control Cracks in 1917

At this time the 16 ft. width was still considered satisfactory and so it was again used. The same thickness was used as on the second mile paved, namely, 6 ins. at the edge and 7 ins. at the center. The crown was raised from 1¼ in. on the previous mile to 1½ in. and it was decided to use reinforcing on this work in order to prevent the formation of cracks as far as possible. One and one-half miles of this was laid late in 1917, and on this stretch an attempt was made to control the location of the cracks. It was realized that cracks could not be entirely prevented, but it was decided so to place the steel that

it would favor the forming of cracks at certain points. The idea of constructing expansion joints was again abandoned as unsatisfactory because they did not seem to prevent the forming of additional cracks. Two ½ in. reinforcing bars were used for longtitudinal reinforcing, one at either edge and ½ in. bars were placed crossways or transversely every 12 ft. It was attempted to secure the formation of a crack every 62 ft. To do this the longitudinal reinforcing did not continue through these points but left a gap of several inches. A transverse bar was laid on either side of this point and about a foot from it. To insure the cracking in a straight line, two 8 ft. bars were placed longitudinally at the center of the paving, extending away in either direction from this point but leaving a small gap where they failed to meet, just as on the continuous bars, so that every 62 ft. there was a line clear across the pavement that had no reinforcing at all.

Winter came on when 1½ miles of this was laid and work was suspended until the following spring. Eighty-four transverse cracks appeared on this 1½ miles and only 13 came at the points at which a gap was left in the reinforcing. Some cracks developed within 12 ft. of these points. It appeared, therefore, that this method of controlling the cracks would not be satisfactory and as a result of this showing the spacing of the reinforcing as just described was abandoned. The reinforcing was run continuously on the balance of the work with the transverse rods every 10 ft. instead of 12. That is, it was continuous for the day's run. The end of one day's run was joined to the next day's run with dowel pins, same as today.

The end of one day's run snowed in the next day and some of this was frosted a little, but until now no evil effects have been noticed.

There are three separate and distinct kinds of aggregate used on this stretch of paving. The east two miles were built of a green trap rock from Dresser Junction, Wis. Then the labor shortage became so acute that the quarry was forced to close down. The contractor then secured a quartzite from Jasper, Minn., and was able to place another 1½ miles when this quarry was forced to shut down for the same reason. On the balance of the work a local gravel was used from Mason City. No difference in the quality of the concrete seems to be noticeable at this time. The cracks on the section on which the gravel was used are a little farther apart, but the subsoil under this piece is also of a gravelly nature and no doubt this has some influence on the cracking.

This piece of paving is in first class shape today. This road carries an enormous traffic during the year. During the summer resort season there is a steady stream of cars in either direction and now there has developed considerable amount of truck traffic and some passenger bus service. With the growth in the volume of traffic it was now found that the 16 ft. width paving was too narrow. It is true that two cars can pass each other on the 16 ft. width but they have to drive straight and carefully to do so and one does not have the feeling of confidence that is had on the wider pavement. In driving on this 16 ft. pavement one can readily tell if the driver in the car ahead is used to driving on paving. He appears to be worried on the one hand with the fear of getting too far to the left and running into a coming car and on the other hand, he is afraid of getting too close to the edge and running off on the shoulder, so that he shifts his car back and forth.

Greater Width Adopted

By the time the next pavement was laid in 1920 it was pretty generally agreed that 16 ft. was not wide enough and since then 18 ft. has been the standard width except in a few cases where exceptional conditions prevailed and a pavement wider than 18 ft. was thought necessary. (I should not forget to state that Cerro Gordo County paved about two miles of County Road System in 1919 and this was paved 18 ft. wide, 7 ins. thick at the edge and 8 ins. at the center). In 1920 the stretch between Clear Lake and the west line of Cerro Gordo County was paved. As just stated the 18 ft. width was now adopted. The thickness was also increased 1 in., this pavement being 8 ins. thick in the center and 7 ins. at the edges. The crown was raised to 2 ins, 1 in. of which was in the subgrade. An additional longitudinal reinforcing bar was also added and the transverse reinforcing was placed 12 ft. apart. Mason City gravel, sand and cement were used in this piece. The contractor hauled a wet batch. The year 1920 marked the advent of the central mixing plant for general use. Some contractors used the central mixing plants and hauled the wet ready mixed batch, others used a central proportioning plant and hauled a dry batch, consisting of the proper amount of gravel, sand, and cement for one batch and this batch was run through the mixer on the subgrade and deposited in the

forms. The use of the mechanical finishing machine also became quite general in this year as did the use of the subgrader.

In 1920 we had our first experience laying pavement on grades. We soon found that the riding qualities of the pavement on the grades were poor because of short, choppy waves. The concrete after being placed and finished off seemed to flow into ridges and depressions, which gave it a poor riding surface. This flow of the concrete seems to continue until the initial set has taken place. These inequalities of surface can be eliminated, however, by using a 10 ft. straight edge carefully to locate the high spots and then by means of a long handled float work them down. This must be done until initial set has occurred. We have found that the importance of using a straight edge on the surface of the newly finished pavement cannot be too much emphasized, even on level stretches. No matter how true the forms may be, or how carefully the form setter does his work, these depressions and high spots will occasionally occur and can only be detected by the use of the straight edge. We have found that a light straight edge fastened onto a 10 ft. handle makes a handy implement.

In 1920 considerable pavement work was gotten under way, under the provisions of the then recently passed primary road law and the proper inspection and testing of materials assumed the proportions of a large task in itself. It was not only necessary thoroughly to test all materials entering into the pavement, but it was required to do this without interfering in any way with the production and delivery of material. To do this the State Highway Commission established a laboratory at Mason City, from which City all sand, gravel, cement and tile were supplied for northern Iowa. This laboratory sampled each car as it was loaded and by the time the car reached the contractor the report was ready. Every carload of material entering into the pavement received the tester's O.K. before being used.

Change of Thickness in 1921

In 1921 the stretch from the Cerro Gordo County line to Garner was paved. By this time it was successfully argued that there was no good reason why pavement should be thicker at the center than at the edges so that it was decided to make the slab uniformly 8 ins. thick. It was also thought that not enough transverse steel had been used in the past, so this was doubled. The spacing on the transverse steel is now 6 ft. Up to now some of the contractors had used the old fashioned way of dumping on the subgrade and then shoveling into wheelbarrows and hauling to the mixer. Beginning in 1921, however, the specifications prohibited this method entirely, and they also forbade the use of horses on the stock piles at the central plant. The dumping on the subgrade has two drawbacks. It prevents the preparing of the subgrade in the proper manner, and a sufficient distance ahead to insure rapid and continuous operation, and even with the best of care, lumps of dirt and mud would get into the concrete which would impair the strength of the slab and if near the surface form pot holes. Horses were barred from the stock piles for the same reason, to prevent the introduction of dirt and foreign matter into the concrete.

Summary of Changes Since 1913

Not much change was made in the design and the construction from 1921 to 1922.

We have then since 1913 the following changes in design:

1. Width increased from 16 ft. to 18 ft. and more.
2. Thickness increased from 6 ins. center to 6 ins. edge to uniform thickness of 8 ins.
3. From no reinforcing at all, we have now in our present design 600 ft. of steel per station.
4. Curves have been gradually lengthened and flattened until now 200 ft. radii are standard for right angle turns with a carefully designed superelevation and transition curves.
5. Shoulders have been widened from 3 ft. to 5 ft. and grade lines are gradually improved.

In construction the outstanding feature is the elimination of the shovel and wheelbarrow method and the development of the central plant.

The central plant, together with the finishing machine and the subgrader, has resulted in the substitution of mechanical labor in the place of hand labor to a marked degree.

This improvement of mechanical devices has resulted in a greatly increased output per contractor per season, one contractor laying 11 miles of 18 ft. pavement in one season with one mixer.

The pavement of today is unquestionably greatly superior to the pavement laid nine years ago. Who knows what the changes may be in the coming nine years, for we are only at the beginning of a large work and are learning all the time.

The foregoing paper by Mr. Zack was presented at the recent annual meeting of the Iowa Engineering Society.

FEDERAL GOVERNMENT TO DECIDE FATE OF LINCOLN HIGHWAY

The fate of the Lincoln Highway as a great transcontinental route, linking New York with San Francisco, is right now trembling in the balance. The vital question of whether or not the road shall be built west of Salt Lake City, Utah, has at last reached the ultimate authority —the Secretary of Agriculture at Washington, who is empowered by Congress to correlate interstate highways.

The Lincoln Highway Association, with headquarters in Detroit, which laid out the route in 1913, before the existence of a federal authority and before there were State Highway Departments in most of the western states, has spent $950,000 in ten years in the promotion and development of the great transcontinental memorial highway. The road has become the most important and most heavily traveled interstate thoroughfare of its length in the Union and has reached a high degree of improvement from New York City to Salt Lake City, a distance of 2,450 miles. The improvement of the road and its strategic location have brought to it such a tremendous traffic that it is becoming a highly important business factor in every community through which it leads.

Vast Traffic Follows Lincoln Way West

The estimates of 1923 traffic, made by the areas it will traverse, show that some 60,000 cars carrying some 240,000 people will traverse the West on the Lincoln Way, spending in the aggregate, between Cheyenne, Wyoming, and the Pacific Coast, over $25,000,000. The construction and proper maintenance of the Lincoln Highway in the West has thus become a question of vital importance, not only to travelers from every section of the Union, but particularly to the vast areas anticipating the business of these travelers.

Every state through which the Lincoln Highway passes between the Atlantic and the Pacific has made the famous route a portion of its federal aid system, with the exception of Utah. Utah has refused to incorporate that section of the Lincoln Highway between Salt Lake City and the western Utah line is its federal aid system, such action precluding the proper completion and maintenance of that highly important section of the road across the Great Salt Lake Desert connecting with the Nevada line and, in effect making Salt Lake City the western terminus of the Lincoln Way. Utah wishes to abandon completely that link in the Lincoln Highway. As this is the road which connects with the main central route across Nevada, that great state is naturally desirous of its prompt improvement. Nevada citizens, chambers of commerces, civic and commercial organizations of all kinds, and her officials, including county commissioners, the State Highway Commission, the Governor and the Legislature, have urged upon Utah without success the inclusion of the Lincoln Highway in her federal aid system and the completion of the road which was indorsed in 1913 by the governor, William Spry, and in 1918 by then governor, Simon Bamberger.

Utah's Plan to End Lincoln Way at Salt Lake

In 1918 Utah accepted $125,000, contributed by the Lincoln Highway Association, and spent it, together with some $80,000 more of state funds, in starting the construction of a satisfactory highway across the Great Salt Lake Desert. That improvement has never been completed. The state did not have sufficient funds to complete it during Governor Bamberger's administration. But the Federal Highway Act, passed in November, 1921, made additional large sums available to Utah from the United States treasury and would have permitted the completion of the last important gap in the road 3,305 miles long. However, the present administration of the state of Utah refuses to build the road. Abandonment of the work already accomplished on the Lincoln Way will mean that it will rapidly become totally impassable, thus blocking all traffic headed for the Pacific Coast on the Lincoln Highway.

The protests of the Lincoln Highway Association, of the Legislature, the State Highway Commission and the Governor of Nevada, and of the people of that state have had no effect upon the "powers that be" in Salt Lake City, with the result that the matter has finally come to the "court of last resort," Secretary Henry C. Wallace, of the Department of Agriculture, of the United States government.

If Secretary Wallace follows the wishes

of the Legislature of Nevada, as formally expressed, the Lincoln Highway will be saved and it can still become America's greatest and most important transcontinental backbone of transportation, and the eternal memorial to Abraham Lincoln conceived by its founders. If the secretary follows the wishes of the present Utah political regime, the Lincoln Highway will cease to be a transcontinental road and become but a road from New York City to Salt Lake City.

Tourists' Convenience or Utah's Profit?

To a large extent the question involved is whether or not traffic shall take the natural, easiest and most direct, safest and most pleasant trend of travel to either San Francisco or Los Angeles, or whether it shall be diverted, rerouted and forced through areas seeking larger proportions of that $25,000,000 a year tourist business, which now forms the stake in the gigantic game of road strategy Utah is playing.

The state of Nevada appreciates that Utah's objection to providing a proper western outlet is based on the obvious desire to make Salt Lake City the division point for that vast volume of through traffic headed for southern California which, if the Lincoln Highway is abandoned and allowed to become impassable in western Utah, must necessarily turn south at Salt Lake City, traversing the entire length of the state of Utah and then following through 400 miles of the Mohave Desert, touching but a corner of Nevada on its journey to Los Angeles.

The remark attributed to Mark Twain, in commenting on his experiences in India, applies with almost equal appropriateness to this Mohave Desert area through which Utah would route all travel for southern California. He said, speaking of the "cool season" in India, that that was a phrase which had come into use in India through the necessity of having some way to distinguish weather which would melt a brass door knob and that which would only make it mushy. July, August and September, the months of greatest tourist traffic through the west, are not the "cool season in the Mohave Desert.

Nevada knows that more than half the travel reaching Salt Lake City and destined for California is headed for southern California and that the best route to southern California is through Ely, Tonapah, and Goldfield, a route which saves the tourists 56 miles between Salt Lake City and Los Angeles and eliminates the intensely disagreeable and almost dangerous Mohave Desert trip. Utah well knows the value to the state of those extra days in Utah forced upon Los Angeles travel if no outlet west of Ely, Nevada, is provided.

Happily, the decision is finally in the hands of a man with no interest in these local strategems for securing the tourist dollars—in the hands of a man who can view the situation from the standpoint of the through traffic and decide it in the interests of all future travel across America. Through travel, or "foreign cars" is 90% of all the travel on the east and west roads of Utah and Nevada. The United States government pays 74% of the cost of the roads.

Until Secretary Wallace pronounces his decision in the matter the continuity of the Lincoln Way as a direct connection from Manhattan to the Golden Gate is threatened. The eight states between Wyoming and the Hudson River, which have done so much in ten years to make the Lincoln Way a connecting actuality, have a vital interest in the momentous decision soon to be reached by Secretary Wallace; momentous because it will affect the travel of hundreds of thousands of tourists in the future. Nevada and California have a tremendous interest at stake.

PUBLIC HEALTH AND WATER CONSUMPTION

By Abel Wolman, Chief Engineer, Maryland State Department of Health, 16 West Saratoga St., Baltimore, Md.

In the discussions on the meter question heretofore presented before the Engineers Club of Baltimore, that elusive individual, "the average citizen," has been subjected to careful analysis with respect to his taxes, his water-rent, his front-foot assessment, his general economy and his public spirit. The Committee of the Engineers Club has felt it only fair, therefore, to present to you some statement, however brief, of the effect of curtailed water consumption upon the "average citizen" himself. After all is said and done, we should know whether a reduction in water consumption will be physically harmful to our residents. If it is harmful, no amount of engineering argument or financial expediency will warrant curtailment of water use. The previous speakers have assumed that a reduction in water use in Baltimore is possible without detriment to the individual or

public health. The pertinent question before us is, therefore, whether this assumption is warranted.

It is my plan to present certain data without drawing therefrom any conclusions. This apparently unsatisfactory plan of presentation is adopted in the certainty that all will have no difficulty in reaching common agreement as to whether or not consumption of water may be reduced in Baltimore without damage to the individual's health and cleanliness. Whether such reduction in consumption, if desirable or possible, should be brought about by metering, or by awakening of public conscience or by some unknown method is hardly within the province of the present discussion. My concern is with the possibility of reduction of water use and not with the technique of its accomplishment. The two problems are entirely distinct, for the first is concerned with the question: Does the "average citizen" use more water than he requires?" while the second asks: "How can we stop him, if he does?"

Water Needs

It sounds comparatively easy to ask how much water an individual needs, but it is not always so easy to answer. The figures usually quoted in the statistics marshaled in any argument for or against water meters mean little except as average indices of current usage. They represent "use," not "need," or "desirability." Current value for per capita consumption may sometimes be lower than that inherent in necessity or desirability, and frequently higher. It is only rarely that the figures are synonymous.

Why should such discrepancies between "use" and "demand" occur? Obviously, use of water is a function of the absence or existence of artificial restrictions, while demand is a function of the natural requirements of biologic life or of sanitation. The amount of water a person uses in a community is rarely as low as his requirements for physiological functioning and for proper sanitation. His consumption is more often determined by purely artificial measures, such as whether the water supply is metered or not, whether it is gravity supplied or pumped, by local prejudices, by previous history, by abundance or lack of supply, than by real demand. In other words, man's usage of water in a modern community is guided by whether he pays for it or not, by his public conscience, by custom and other external contingencies. These distinctions are emphasized here because in them lies the origin of the confusion which arises when we speak of man's water requirements and his health.

Rational Requirements

Man has certain minimum requirements for water in order to continue to function. The human mechanism demands water for its proper functioning, just as an automobile engine demands gasoline. The ton-miles per gallon of gas differ with different engines, at different temperatures, at different speeds, etc. In the same way, the human engine has varying requirements for water, one of the constitutents of its driving power. But the maximum requirement of biologic man for water is ridiculously low in comparison with the figures for water consumption with which we are familiar.

The "subsistence demand" of man, if we may so term his metabolic water requirement, is one of the rational requirements of man. It is rarely over a gallon and a half a day and is frequently less. The British troops of General Allenby in their forced marches against the Turks used as low as one pint of water per man per day. It is hardly wise to assume such a minimum rate, even though experience may indicate no harmful results. We are safe, however, in accepting the figure of 1½ gals. per man per day as a rational value for "subsistence demand."

The modern individual has another demand which is quite as worthy of fulfilment as his "subsistence demand," namely, a "sanitary demand." As modern sanitation developed, man's use for water increased, as it should. Such legitimate increases, however, were frequently perniciously employed to excuse illegitimate and wasteful increases in consumption which occurred simultaneously therewith. The "sanitary demand" of the individual is that covering the usage for bathing facilities, washing of clothes, toilet equipment and minor necessary household uses. Measurements have been made from time to time in large communities of the total water used for above purposes in typical areas. It is commonly found that this figure for "sanitary demand" varies between 10 and 20 gals. per person per day.

The sum of the "subsistence" and "sanitary" demands range from 15 to 25 gals., therefore, per day for the domestic consumer. If we pursue the usual custom of engineers, we may extend this figure to include a factor of safety, giving a "maximum rational water requirement" of 30

gals. per person per day in domestic service. We take no account in this evaluation, of course, of commercial or public usage of water, for these should not be confused with the individual's personal use. They represent an added necessity, but they should be separately tabulated as remote in their effect upon the public health.

Is this "maximum rational requirement" of 30 gals. per capita per day, for domestic purposes, a hypothetical desideratum or a practical accomplishment? In other words, should calculation supersede experience in determining the allotment of water to consumers? Fortunately abundant evidence is at hand to confirm the conclusion that many communities have used quantities of water for many years which agree, within reasonable limits, with the rational individual demand above indicated. It would be useless to quote such figures at length here, but I shall take the liberty of referring to a few examples to satisfy all that the "rational demand" set up by the present writer is not irrational.

It has been common knowledge for decades that American cities are notoriously wasteful of water in comparison with foreign communities. It is also as well known among persons familiar with mortality statistics that in many of those foreign areas the death rates from waterborne and other diseases have been lower than in American cities. It is only in recent years, for example, that the typhoid fever death rate in Baltimore has approached within range of the low rate for this disease which London has had for decades. And yet the daily per capita consumption of water in London is less than 50 gals., while the average for the principal towns in Great Britain is only 42 gals.

A survey of American mortality statistics does not indicate any correlation of frequency of incidence of disease with varying amounts of water consumed or with whether a community is metered or not. The correlation of water and disease, in the bulk of cases, lies in the factor of quality and not of quantity of water consumed, for, in most instances, in this country, water consumption is well above the rational requirement and usually above 50 gals., which we may designate the "maximum reasonable use." Beyond 50, however, the irrational use of water for the domestic consumer begins, for in this upper zone lie the demands upon a system made by waste and leakage. The responsibility for waste and leakage rests with both individual and municipality. It is in this region that curtailment may well be made without damage to health.

Maximum Reasonable Domestic Consumption

The establishment of a "maximum reasonable use" of 50 gals. per day for the domestic consumer has additional support in the facts which may be gained from the experience of American cities which have adopted water meters. As their per capita consumption decreased, the typhoid and total death rates fell. It would certainly be rash to assume that the two phenomena had anything to do with each other. Yet, it is probably as accurate to state that reduction in water use decreases the death rate as increase in water use decreases the death rate, for both conclusions are by no means obvious or necessary. Reduction in water use may increase the death rate, if such use were reduced below the rational demand to the region of "subsistence demand," because then interference with the communal and individual equipment for sanitation results. To say, however, that reduction of the individual's use from 100 to 50 gals. per day implies higher mortality is equivalent to saying that the substitution of a good washer for a poor one on the tap at the kitchen sink will cause a greater frequency of disease. In either case we are merely curtailing an irrational usage of water, without interfering with a rational demand.

I am not prepared to state, of course, that the reduction of domestic use in Baltimore will be brought about by meters, for we must first know whether the irrational use originates in the leakage and waste in the public or in the private distribution system. Much depends upon the source of this irrational demand, if it is appreciable, as to what procedure is desirable or economical for its elimination.

The Cleanliness Argument

My purpose has been to point out that the requirements of the human mechanism for water for continuance of life and for proper environmental sanitation are relatively low. In only few instances, do such requirements control the actual per capita consumption in a community. It would be a better statement of our case if we were to revise the usual argument for unlicensed water use, namely, that "cleanliness" may be reduced by curtailment, to the more accurate phrase, that

TABLE I.—DATA ON WATER CONSUMPTION—METROPOLITAN BOARD OF WATER SUPPLY AND SEWERAGE, NEW SOUTH WALES, AUSTRALIA.

Year	Population Supplied	Average per capita Consumption Gallons (U.S.) (for all purposes)
1911	731,180	49.8
1912	776,065	50.4
1913	830,560	52.8
1914	878,790	49.0
1915	917,990	51.5
1916	968,215	50.0
1917	993,000	49.9
1918	1,021,540	53.5
1919	1,060,230	54.4
1920	1,109,430	52.5
1921	1,146,370	53.3

TABLE II.—ENTERIC FEVER IN ADMINISTRATIVE COUNTY OF LONDON, ENGLAND.

Year	Deaths per 100,000
1911	3.0
1912	3.0
1913	3.0
1914	3.0
1915	War Period Rates Unreliable
1916	War Period Rates Unreliable
1917	War Period Rates Unreliable
1918	War Period Rates Unreliable
1919	War Period Rates Unreliable
1920	War Period Rates Unreliable
1921	1.0

Population supplied approximately, 4,500,000.
Average water consumed per capita per day in 1921-22, approximately 50 gals. (U. S.) for all purposes.

TABLE III.—PER CAPITA CONSUMPTION ALLOWANCES FOR VARIOUS CLASSES OF COMMUNITIES SERVED BY APULIAN AQUEDUCT SYSTEM, SOUTHERN ITALY.

U. S. Gals. per Cap. per Day	Communities (Population)
32.8	Bari, Lecce, Foggia, Barletta, Toranto
	Gravity Supply
22.2	More than 20,000
19.2	10,000—20,000
16.9	5,000—10,000
15.6	5,000 or less
	Pumped Supply
15.6	10,000 or more
14.4	5,000—10,000
12.7	5,000 or less

Population to be served, 3,000,000.

TABLE IV.—DATA FOR BALTIMORE

	Typhoid Fever Deaths per 100,000	Water Consumption Per Capita Per Day
1911	27.1	120
1912	23.6	
1913	23.1	
1914	22.0	
1915	20.3	
1916	17.1	
1917	15.0	
1918	11.6	180
1919	8.2	166
1920	4.7	
1921	5.6	142+—

"water consumption" represents not only a demand for cleanliness but a wasteful usage. Nor is this irrational wasteful use always restricted to the consumer, for in some communities the water, fire and street cleaning departments also invoke the "cleanliness" argument to explain away their human frailties. It should be emphasized that a leaky main or a fire-plug left open while the moody street cleaner discusses at length the dangers of civilization with the innocent bystander, bring us no closer to the path of cleanliness, yet this quantity of wasted water appears later in the innocent role of defender of health and welfare. We should be wary of the false god of cleanliness, "waste," while we protect the real one, "rational usage."

I have not attempted to burden this paper with tabulations to support my brief, but there are appended hereto several typical exhibits which may serve to illustrate the argument analyzed above.

In closing, I may summarize by saying that I consider the "subsistence demand" to amount to 1½ gals. per person per day; the additional "sanitary demand," from 10 to 20 gals. per day; the "rational water requirement," 15 to 25 gals., with a maximum of 30 gals.; the "maximum reasonable use," 50 gals. These values should be compared with an average present use, which includes irrational waste and uncontrolled leakage, commercial and municipal use, of 142 gals. in Baltimore.

The foregoing paper by Mr. Wolman was presented before the Engineers' Club of Baltimore on March 21, 1923.

IRON ORE USED IN LOUISIANA ROADS

Iron ore, found in northwestern Louisiana, has proven of great value in road building in that state and, in some localities where it has been used, has effected a saving of $2,000 to $3,000 a mile in the cost of construction. Highway engineers in Louisiana have been using the ore as a binder instead of sand clay and have found it far superior to that material in many instances. During 1922 the Louisiana State Highway Department completed 350 miles of new roads. Most of this mileage consists of gravel. The remainder consists of roads built of shells, sheet asphalt or bitulithic.

Iron ore was first used in DeSoto Parish, La., in 1917. Then a large deposit was found northwest of Arcadia. Ore from this deposit is being used as a base course on the new Homer-Minden Highway, the Arcadia-Natchitoches Highway, the Ruston-Arkansas Highway and the Pershing Highway. The state pays about 10 cents a yard in royalties for this material against $1 a yard on sand clay gravel.

Construction News and Equipment

USE OF CONVEYORS TO SAVE LABOR AND PREVENT ACCIDENTS IN MATERIAL HANDLING

By H. L. McKinnon, Secretary, The C. O. Bartlett & Snow Co., French St. and Columbus Road, Cleveland, Ohio.

First, I would like to classify the various types of conveyors generally in the following manner: 1. Screw conveyors. 2. Bucket elevators. 3. Belt conveyors. 4. Apron conveyors. 5. Flight conveyors. 6. Skip hoists. 7. Portable cranes. 8. Bridge cranes or tramways. 9. Monorail system. 10. Air and steam jet systems.

Just a word of explanation as to these various types of conveyors and the ordinary safety precautions which are taken in the manufacture of each.

Screw Conveyor

This type of equipment is usually built in a completely enclosed trough, having a removable cover and suitable gates in the openings for receiving and discharging the material. The operation of the equipment is merely that of the helix or screw moving the material forward in the trough by means of the spiral flight which is supported usually on a hollow shaft and is driven through this shaft by a gear or other drive at end of the trough.

It is easy to see that an equipment of this kind when totally enclosed, practically eliminates any chances for accident in its operation if the gears and drive are enclosed, also, as may be readily done. Normally there is no possible opportunity for accident. Yet, it is one of the most painful recollections of the writer that one of the worst accidents which he ever witnessed was in connection with just this kind of equipment. The conveyor in question was in a warehouse containing finished Portland cement, and a series of gates from the various bins were provided in the chutes leading to the conveyor in question. The operator found one of these gates a little hard to open and rather than take the necessary trouble and time to get a bar and force the gate open, he attempted to kick the gate and in doing so, missed it, putting his foot in the conveyor, which promptly resulted in amputation a little above the ankle. Such accidents are by no means rare and are the direct result of carelessness, although the possibility for accident is always present when an opening is provided with removable cover over any moving piece of machinery. These screw conveyors are rarely used to handle anything but a fine material or at least a granular product with lumps in no case larger than one-quarter the diameter of the helix.

Bucket Elevators

Great variety in the design of bucket elevators is noted and there are certain limits in the practical constructions of this class of equipment. Bucket elevators may be either vertical or inclined at an angle to the horizontal. They can be used for a wide range in material but the size of the product to be handled will determine in every instance the minimum size of elevator that may be used for any particular purpose. It is usual completely to enclose bucket elevators where they are vertical and where they handle a product that is likely to create dust. It is not, however, essential from the standpoint of safety that they be placed in a dust-proof casing. It is, however, desirable to protect elevators at any point where there is an operating floor or where men can come in contact with the moving line of buckets and chains or belts as the case may be. It is also usual to protect the gears on the drive so as to prevent accidents, due to the attendance rendered necessary for the oiling and maintenance of parts. There are a great many bucket elevators, however, built on incline with the horizontal where the construction is of skeleton nature and the moving parts are exposed. Where the rate of travel is slow, this need not necessarily be dangerous provided the outer ends or the rolls and chains are protected, so that the clothing of an attendant cannot be drawn under these parts so as to cause accident.

Such elevators are frequently provided with guard rails on the outside of the bucket line so that in the event of a breakage of chain or belt, the buckets will be held in position without being allowed

to roll down to the foot end of the conveyor and in so doing, probably injure workmen in so dropping.

Many devices are resorted to by conveying engineers to render such equipment entirely safe under the most adverse operating conditions.

Belt Conveyors

The uses to which belt conveyors are now applied are so various and so comprehensive in regard to the materials handled as to present a great variety of problems in making the conveyor safe in continuous operation. In the first place, belt conveyors are usually operated at fairly high speeds, which makes the chance for accident greater than is the case with slower moving equipment. They are operated at speeds in some instances as high as 2,000 to 3,000 ft. per minute, in which cases material is thrown from the end of the conveyor at a corresponding velocity and momentum.

If a workman should get in the path of material moving at such a rate he has scarcely an opportunity of getting away uninjured. The great majority of belt conveyors however, are operated at speeds varying between 200 and 400 ft. per minute, which latter speed is not much in excess of normal walking speed for a healthy full-grown man, and it is usually possible for any one who is alert to avoid possibility of accident with this class of equipment if it is properly constructed and supported. It is, of course, essential that the drives, especially the gears, be protected in the same manner as has been specified for previous items. It is now usual to make belt idlers for conveyors so that there is no possible projection which could catch loose clothing or anything else in the movement of these idlers. One of the most important things to be considered from the standpoint of safety is that the practical means of lubrication be provided with such regard to safety precautions as would make it practically impossible for the person operating the lubricating system to become in any way injured with moving products.

Apron Conveyors

The term above mentioned, namely "apron conveyors," is usually employed to designate a type of conveyor which is jointed and yet in all other essential particulars is similar to the belt conveyor described in the previous item. With apron conveyors, however, it is quite usual, and in fact general, to supply sides on the conveyors which make them act as a trough and the same problems are presented as in the open type elevator in the matter of projecting chains and idler wheels which are carrying the load. Guard rails should be provided in this class of equipment so as to eliminate any possible chance, if the apron conveyor is on an incline, of the material piling up at the foot end due to the breaking of the chain or other parts. The same general conditions in regard to drive protection are necessary on this as in all other instances.

Flight Conveyors

We here come to the discussion of one type of equipment which, while it is usually slow-moving, does have possibilities for accident, due to the fact that it is usually supported in an open frame work of structural steel or wood, which will permit individuals to fall in it if it is not otherwise protected, or the further possibility of allowing bars or other equipment to fall into the equipment. If they are too long to fall into the conveyor directly, they are liable to catch in the construction and injure anyone in passing. These flight conveyors are used for a great variety of materials and are practically the only type that can be used successfully on certain materials, such as household waste, commonly called garbage. Products of a similar nature, if handled in conveyors, usually must be handled in an equipment of this type, especially if there is more than one point of delivery from the conveyor. Belts or aprons can be used for the conveying of materials of this character if delivery is only at one point. It is quite practical however, to protect by means of hand rails and toe boards, this class of conveyor in such a way as to render it perfectly safe for the operator.

Skip Hoist

This term is used to cover the form of elevating equipment which consists of one or two buckets either balanced or not, as the case may be, which are used as a hoisting tower and hoisting engine so as to elevate any material which can be readily placed in the buckets and hoisted and dumped in any desired position. This class of equipment consists essentially of a loading hopper with suitable gate and gate mechanism, the bucket guides or hoisting frame and the hoisting engine itself together with the dump chute or hopper for receiving material.

It is generally easy to protect the hoisting tower in such a way that even if a rope breaks, the bucket will only drop directly in its guides and fall to the bot-

tom without endangering the life of any individual.

Many things have been done in the construction of skip hoist equipment to render it as safe as possible and as in the case of all dryers, the gears are to be completely enclosed.

In the more modern equipment, there is usually provided limit switches where the equipment is operated by electric motors so as to control the travel in either direction. In addition, the slack cable device is frequently employed in the event that the rope becomes slack, due to the bucket sticking in the guides. This immediately cuts off the power.

Still further safety is obtained in the event that the bucket is hoisted to too high a position; that is, above its normal dumping point. Various devices have been provided so as to hold the bucket locked in position when it is carried above its proper limits. These are intended for safety, and also for reduction in risk to the equipment, due to the faults which might develop in the operation.

Locomotive Cranes

The type of equipment here mentioned is familiar to all and the use in industry is so general as to need no explanation.

Aside from the proper covering of driving mechanism gears, it is necessary to be sure that the various parts of the equipment are sufficiently strong for the service in which the machine is operated. In the writer's experience, the greatest danger encountered in the operation of this type of equipment is in the handling of heavy equipment where it has to be placed together in other parts for proper assembling. It is then that the man who is directing the operation comes to be in danger, first, in attempting to guide two parts together and possibly due to the failure of ropes or brakes on the equipment itself. There are, however, a large variety of uses for this kind of equipment where it can be handled with perfect safety and to the great advantage of the business using the equipment.

Bridge Cranes or Tramways

We do not propose to discuss at any great length this type of equipment. All that has been said in the previous item in regard to the handling of materials with a locomotive crane applies with equal force to the handling of parts on the overhead traveling or bridge crane, or with a bridge tramway which is usually used in connection with clam-shell buckets or drag lines. The same general principles of protection against accident apply to this equipment as in the previous item.

Monorail System

We come here to a type of equipment which is a modification of the cranes in the two previous items, but on account of its flexibility in switching from one track to another, it has been used in a great variety of places where bridge cranes could not be used without great expense. However, we have observed in connection with this kind of equipment that the use of switches getting from one track to another involves great risk of accident.

To the writer's personal knowledge in one foundry where switches are not permitted, no serious accidents have been caused in the handling of molten iron in hot ladles in monorail system, while in another foundry owned by the same interests and operating on identically the same class of work, seven or eight persons have lost their lives in a few years, due to the spilling of hot iron when the monorail equipment runs into an open switch or one improperly set, which suddenly stops the trolley.

It is the writer's opinion that this type of equipment is, from the very nature of its construction, difficult to protect from this standpoint. Suitable bumpers and automatic stops probably could be designed or a system of signals employed which might relieve this mechanism of defect mentioned.

Air and Steam Systems

As a means for transferring material from one point to another, steam and air have been used for many years. There are certain objections to this type of conveyor, chief of which is its inefficiency from the standpoint of the power required to operate. The efficiency of such type of equipment in only rare instances is as high as 15%, and is more often under 12%. Such an equipment is practically accident-proof, however, except due to defective containers for air or steam and the possibility with the use of steam, that the operator might come near the outlet and become scalded due to an excess of steam passing through the equipment.

With these descriptions of the various types of conveying equipment, and considering the diversity of materials which must be handled, nothing but the most general statements can be made which would have application to the question before us. We believe, however, that we

are safe in making this assertion, namely, that where materials are handled by mechanical means, which means conveying systems as opposed to operating by hand, the chances for accident are reduced in two important ways:

First—In a reduction of the number of operators.

Second—In the freedom of the mind of the operators required in connection with mechanical equipment so that they may guard against accident.

The writer has made a special study of labor-saving by the use of mechanical equipment in the foundry industry and has found some very remarkable instances in reduction of men required to produce a given amount of work. We have in mind one instance where the output of a plant was increased 60%, the floor space occupied with work reduced 50%, and the number of employees cut in half. Working conditions were so much improved in this plant that when it was found necessary to shut the plant down in the fall of 1922 for a period of six weeks, all of the help were paid off excepting the foundry foreman. These men obtained work in other plants, but when the plant under consideration was ready to again begin operation, a post card sent out three days in advance, brought back all of the employees but four on the first morning of operation, and on the third day of operation, all the old employees were in their places. We have not the figures from this concern in regard to the number of accidents before and after the installation of the equipment, but feel sure that they will show in the right direction.

We have, from another customer, the statement that the number of accidents per ton of castings produced, had been greatly reduced by the addition of mechanical equipment and they verify this statement by their dispensary record.

Another gentleman in charge of safety work for a branch of the Steel Corporation stated to the writer that there is absolutely no question but that the use of mechanical equipment for the handling of materials has reduced their accident record, and why should this not be so?

In the first place, conveying equipment is made to do the thing in the easiest possible way; that is, with the least expenditure of total effort. Again, by the use of mechanical equipment, feeders may be installed so as to transfer material from bins to conveyors, provide for an even and continuous flow, and eliminate the guess work of hand feeding which, in some operations, when fed too fast or too slow, are liable to produce causes for accident.

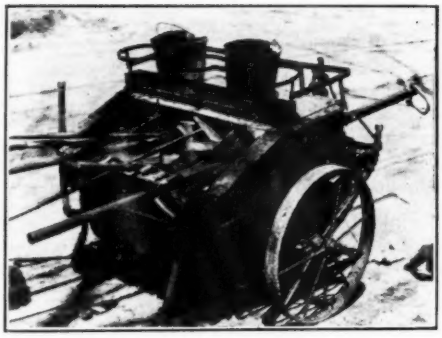
The foregoing paper was presented recently in Chicago before the mid-year conference of the Safety Council.

CHAUSSE OIL BURNING ASPHALT TOOL AND SURFACE HEATERS

Shortage of labor for street and highway repair work has caused considerable interest in the return to production of the Chausse oil burning apparatus for repairing asphalt streets with greater efficiency and economy than is experienced through the use of manual labor only.

The wide necessity for increased economical maintenance of asphalt pavements, the advantage of hot patching over cold patches and the saving of both time and money secured by the use of improved machinery has focused attention on apparatus for rapid street repairing.

About five years ago Chausse machines

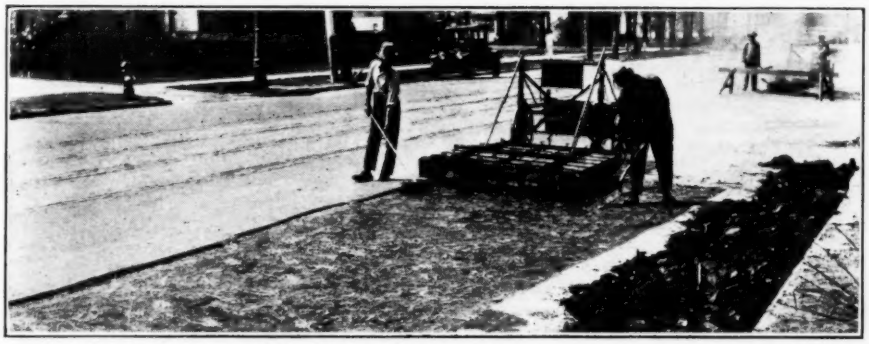


VIEW OF IMPROVED CHAUSSE ASPHALT TOOL HEATER.

were introduced to street and highway departments and through two years of production made enviable records. With improvements made in these machines, ample production facilities and a record of success behind them the Chausse oil burning tool and surface heaters have been returned to active distribution. The accompanying illustrations show Chausse tool and surface heaters which are used in a great number of cities and by a large number of contractors. The new features of these machines combine meritorious features of the old apparatus with refinements which have been found desirable.

The tool heater as illustrated is now equipped with rubber tires, Timken bear-

ings and steady rests and a new type of burner. The artillery wheels and roller bearings make possible more rapid and noiseless transportation so that they can be hauled at any speed behind motor trucks. The new burners are more efficient and unaffected by the high temperature generated. The new steady rests both front and rear, prevent tipping and these machines can readily be pushed by one man. The surface heaters have been improved by more efficient burners and lifting apparatus and refined insulation.



VIEW OF IMPROVED CHAUSSE ASPHALT SURFACE HEATER IN OPERATION.

Chausse tool heaters or fire wagons will bring 14 or 15 cold tools up to a proper temperature in 15 minutes and provide space for heating 3 buckets of cement so that two gangs can work on one machine if necessary. The burners will generate maximum temperature in 5 minutes as it is no longer necessary to build up coal or wood fires long in advance of the machine's use. They eliminate smoke, sparks and ashes and are not affected by rain or wind. Sufficient kerosene or distillate is carried for two 8-hour days of continuous burning at maximum temperature. The fact that there is no danger in the use of these machines and no possibility of damage to awnings or objections from householders make them more satisfactory, it is claimed, than coal or wood burning apparatus.

Chausse surface heaters are made in two sizes, one to cover 2 sq. yds. and to work up to street car tracks without interfering with car movements. The other covers 4 sq. yds. and both machines are mounted on springs to prevent damage in transit, and both fold up to facilitate transportation. The cutting edges all around the burner hood give clean straight joints and it has been found possible in actual service to melt down old asphalt to 1-in. depth in 4 to 5 minutes. As much as 600 sq. yds. of asphalt has been heated to a 1-in. depth in an 8-hour day. In the city of Detroit, one Chausse surface heater and 2 men were able to do the work of 4 men chopping out, and at the same time saved 1 in. of asphalt and 1⅛ in. of binder in addition. Hand chopping meant taking out everything right down to the base so that the Chausse machine saves both labor and material and in the completion of approximately 80,000 sq. yds. of asphalt repairing the Chausse heater reduced the cost from $1.22 to 97 cts. per sq. yd.

These machines are now being offered to the trade by the Chausse Oil Burner Company, with offices at 206 Lincoln Building, Detroit, Mich.

USE CENTRIFUGAL PUMP TO ICE LOGGING ROADS

Indicating the widespread and varied uses of the little Evinrude Centrifugal Pump, one is now at work icing logging roads in the Canadian north woods near Hudson Bay. This is the Evinrude's "farthest north" to date.

The pump is slung down a water hole and lifted up to drain, to prevent freezing.

Its owner is one of the Dominion's large lumber companies, and the order was filled by Watson, Jack & Co., Ltd., Montreal, who represent the Evinrude Motor Co., Milwaukee, in Canada.

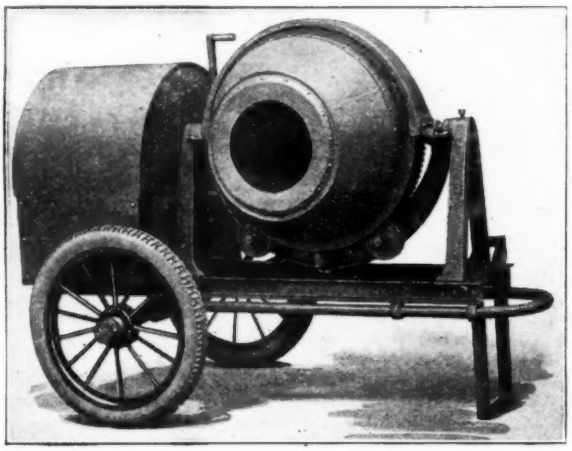
NEW MACHINE IN SMALL MIXER FIELD

Now and again some invention or development is brought out which, because of its importance, causes an unusual amount of comment. Such is the case with the new Smith 375 Tilting Mixer just being placed on the market by the T. L. Smith Co., of Milwaukee.

This little half-bag mixer is built along exactly the same lines as the larger known mixers of larger size. The double cone drum is known for its fast continuous production and speedy discharge (just like emptying water from a bucket). The tilting lever operates easily and locks in the discharge position. The drum returns to the mixing position automatically as soon as the lever is released. No time or effort is wasted.

SMITH 375 HALF-BAG TILTING MIXER, FOUR-WHEEL MODEL SW-1, CHARGING SIDE WITH FEED CHUTE AND LOW CHARGING PLATFORM.

The new mixer has a mixed batch capacity of 3¾ cu. ft., or a full half-bag batch of 1-3-6 mix with materials containing the usual 40% voids. It supplements the Smith line of tilting mixers and meets a real demand for a small size mixer of design and merit.



ANOTHER VIEW OF SMITH ½ BAG TILTING MIXER. PRESSED STEEL WHEELS ARE FITTED WITH CLINCHER RIMS FOR FORD 30x3½-IN. PNEUMATIC TIRES.

Smith tilting mixers, known to contractors for over 20 years. The double-cone drum, the central gear ring and roller track, the independent tilting frame—these are all the same as on the well-

In spite of its small size, it is claimed

that this mixer is the best made machine in the entire Smith line. The inspection is extremely rigid and the parts are made to very close tolerances. The main drive gear and the engine pinion are machine-cut. The bevel drive pinion is made of 40% carbon electric steel. The chilled thrust rollers have enclosed dust and moisture-proof ball bearings. The bolster castings are of electric steel and the operating levers of malleable iron. The power plant consists of a 1½-h.p. Fuller & Johnson engine, equipped with a magneto. It is completely housed.

The feed chute is made of No. 12 gauge steel plate. The charging platform is built of 1½-in. boards bolted to heavy steel angles. The height of this platform is 30½ ins.; width, 32 ins.; length, 42 ins.

Smith 375 Tilting Mixers are built in two models. Model RW-1 is equipped with two pressed steel wheels fitted with clincher rims for Ford 30x3½-in. pneumatic tires. Model SW-1 has four steel wheels, 24 ins. in diameter and 3-in. grooved treads. Axles on both models are made of cold rolled steel, 1¾ ins. in diameter.

The two-wheeled model RW-1, with its light weight (only 1,100 lbs.) and pneumatic-tired wheels, is the last word in portability. With a hauling stub that is so arranged that it can be drawn out for readily attaching the mixer to an automobile, truck or wagon, this little mixer can be towed quickly from one job to another. While the mixer is being moved, the front supporting leg is folded up out of the way.

THE CARR ROAD FORM

The Carr Road Form, recently placed on the market by the Lakewood Engineering Co., Cleveland, Ohio, has a number of distinctive features. The cross section of the form is made by 3/16 in. metal. The locking arrangement consists of two simple wedges and insures accurate and rigid connection of sections.

The sections of form are made in 12-ft. lengths, which is 20% longer than has been customary for road forms and decreases the number of joints to be made and the sections to be handled in a given distance.

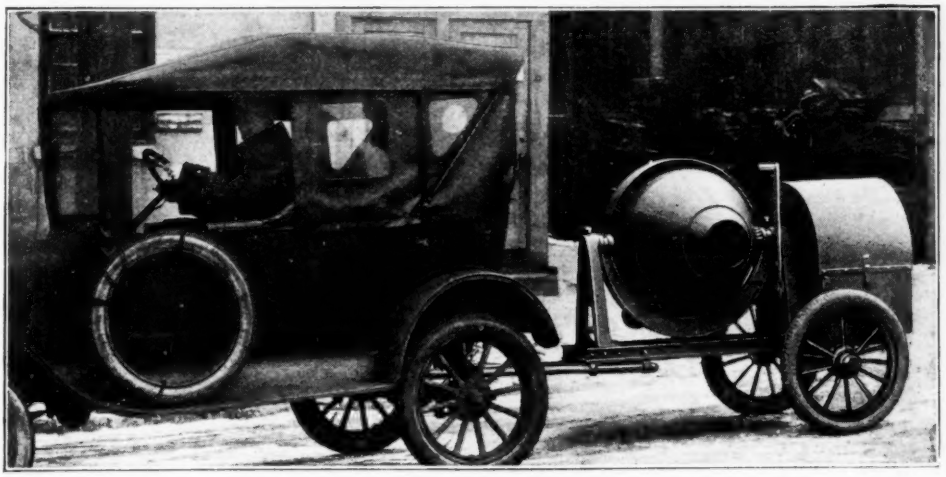
One of the most important features of the form is the Line Point Top Surface, which is secured by the rounded top. No concrete or stones can lodge here to get under the wheels of the finishing machine or subgrader to cause them to ride high.

The form is practically self-cleaning. Edging is made easier because of the uniform top and smooth joints which result from the rigid connection between sections secured by the wedge members.

Flat stakes having a penetration of 18 ins. and which can be driven anywhere along the base of the form are another point of superiority. The shape of the stake gives it maximum resistance against displacement.

The base is 5 ins. wide and furnishes ample bearing to support the forms when carrying mechanical finishing and subgrading machines.

These forms were used on several jobs last season in order to thoroughly try



VIEW SHOWING METHOD OF TOWING SMITH ½-BAG TILTING MIXER BETWEEN JOBS AT HIGH SPEED.

them out before placing them on the market. These jobs proved that the advantages of the form are of real practical value.

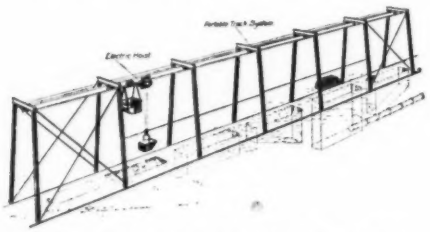
ELECTRIC HOIST MONORAIL SYSTEM FOR LAYING SEWER PIPE

A most effective method of laying sewer pipe has been put into operation by a contractor in Hagerstown, Md., which will appeal to contractors doing similar work or confronting like conditions.

Confronted with narrow streets and the necessity for keeping them free from the usual obstruction that results with the removal of dirt, this contractor employed a system whereby he might dig his trenches, lay his pipe and cover the completed work progressively.

This was accomplished by using the portable monorail, electric hoist system, illustrated in the accompanying line drawing. The simplicity of the design and construction makes the drawing immediately self-explanatory.

Not only does this system do away with



HOIST MONORAIL SYSTEM FOR LAYING SEWER PIPE.

the necessity of obstructing streets and sidewalks with dirt, but it cuts the cost of operation in half. This, because the dirt is handled only once instead of twice —the digging of the advance trench, the laying of the pipe in the dug trench and the covering of the completed work being done simultaneously.

The system, which is assembled in sections, trolley included, has but one requirement, that of access to electricity. This can usually be had without difficulty. By merely backing a heavy truck against one end, the whole structure is easily and readily moved along the T-rails. This is done as the work progresses. The electric hoist used on this outfit is of the "C-2" type with a capacity of 3,000 lbs., amply capable of caring for the deepest sewer or the heaviest pipe. Because of the exceptionally low first cost, coupled with the low operating and maintenance expense, this system is profitable on small as well as large jobs. The system was designed and erected by the Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill.

THE "SCHRAMM" FIRE PUMP

One of the most recent and interesting developments in fire-fighting apparatus is the "Schramm" fire pump manufactured by Schramm, Inc., at West Chester, Pa.

Every community, no matter how small, has a desire and need to own a fire-fighting apparatus in order that it may be more independent of the larger towns adjacent to it.

It does not have sufficient use and is hardly in a position to equip with an elaborate unit costing several thousand dollars, but is in a position to purchase a "Schramm" fire pump costing only a few hundred dollars, which will give adequate protection.

This unit consists of a 5-h.p double cylinder, throttle-governed, gasoline engine, designed especially to meet the requirements of this outfit, direct connected by means of broad-faced, machine-cut gears to a 3x3½ in. triplex pump, delivering 4,800 gals. of water per hour at 100 lbs. pressure.

The engine is of the double cylinder, horizontal type, each cylinder having a bore of 3¾ ins. with a stroke of 4½ ins. Speed control is of special design to suit this particular engine. Operating at its full rated speed, 690 revolutions per minute, the engine under brake horsepower test, develops 5.529 horsepower.

The pump is designed for exceptionally heavy duty. The pistons are of brass and the cylinders are brass lined. This prevents both the cylinders and the pistons becoming corroded due to water laying in the cylinders when the pump is not in use. The pump is designed with extra large valves and water passages so as to obtain low water velocity.

The entire equipment is mounted on a sturdy rubber-tired truck with drawbar and equipped with a basket for holding the discharge hose. The basket is also equipped with bracket for holding the suction hose in place.

One of the main features of this equip-

ment is its light weight. Complete, but less the hose, it weighs approximately 1,400 lbs., so light in fact that it can be attached to the first available motorcycle with side car, automobile or wagon that should appear and hauled over the roughest country roads to the fire. If none of these are available, then the outfit can be hauled by two men. The light weight, compact construction and even balance, coupled with the fact that the wheels are equipped with roller bearings, make it an easy matter for two men to pull the outfit.

The size fire nozzle and the number of streams of water which this pump will supply depends entirely upon local conditions and the nearness of the water supply to the fire.

VALUABLE TRADE LITERATURE

(Editor's Note: Copies of the catalogs and leaflets here briefly reviewed may be obtained by writing direct to the addresses given in the reviews or to this magazine.)

Concrete Mixer Catalog—The T. L. Smith Co., of Milwaukee, has just published a new 48-page catalog, No. 405-C, describing and illustrating the Smith line of non-tilting concrete mixers, 4-S to 28-S sizes. Attention is directed to the efficiency of the end-to-end center mixing action and to the speedy discharge obtained by extending the discharge chute two-thirds of the way into the drum. Among the new features mentioned are the Smith water measuring tank, the use of 4-cylinder, truck-type motors for the larger sizes and a choice of either 2-cylinder or single-cylinder motors for the 7-S and the furnishing of rubber-tired wheels on certain sizes when specified. In addition to the usual specifications, dimensions, proportion and capacity table, the new catalog also contains a very practical table on weights and cubical contents as boxed for export.

Half-Bag Tilting Mixer—The T. L. Smith Co., of Milwaukee, Wis., has just issued an attractive 4-page folder describing the company's newest product—the Smith No. 375, a half-bag tilting mixer that is of the same general design and quality as the regular line of Smith tilting mixers, known to contractors for over twenty years. The folder is printed in two colors and contains a number of illustrations of both models of the 375. The condensed specifications show that model RW-1 has two bronze-bushed steel wheels equipped with clincher rims suitable for Ford 30 by 3½ pneumatic tires. Model SW-1 has four steel wheels, 24 inches in diameter, with 3-inch grooved treads. According to the company, this little brother of the big Smith tilting mixers is the best mixer value ever offered to the trade.

Steam Heating—Several bulletins of exceptional interest and value pertaining to steam heating have been issued by the American District Steam Co., of North Tonawanda, N. Y. Bulletin No. 158 tells in a very brief but most interesting way about the ADSCO System of Atmospheric Steam Heating, gives a clear view of how the System works and the results which may be expected from it. Bulletin No. 159 on the other hand gives more technical data useful to the heating contractor and architect. This book explains how radiation should be figured for the ADSCO System, also how the system should be laid out and installed. This is a valuable book for anyone who is called on to figure heating plants for small or large buildings. Booklets Nos. 20, 154, 157 and 160 cover the topic of heating groups of buildings from one central plant. Nos. 157 and 160 have a personal touch insofar as they tell about a specific installation. This information is especially interesting to Electric Light Plants who generate electricity by steam for they can utilize the exhaust steam for Central Station Heating, thereby making this expansion a very profitable investment.

Steam Sovels—A series of folders on steam shovel construction is being issued by the Thew Shovel Co., Lorain, Ohio. A folder is issued each month.

Steam Boilers—Bulletin 23-A on Uniflow improved return tubular boilers has been issued by the Lebanon Boiler Works, of Lebanon, Pa. This is a 3½x6-in., 24-page booklet illustrating and describing these boilers and their operating principles and advantages.

Wood Pipe—A catalog describing Continental wire wound wood pipe, continuous stave pipe and creo-wood flume has just been issued by the Continental Pipe Mfg. Co., Seattle, Wash. This is Catalog No. 18, 6x9-ins., 250 pages. This is a very valuable book for anyone at all interested in the subject of wood pipe and its many uses.

Tractors—"Caterpillar Tractor Performance" is the title of an exceptionally well compiled and printed catalog of 40, 8½x11 in. pages recently issued by the Holt Manufacturing Co., Inc., of Peoria, Ill.

The catalog contains a very large number of illustrations of the use of these tractors in industry and agriculture. These pictures illustrate the very wide range of economical application of this type of equipment. Specifications of the 10, 5 and 2 ton tractors are also included.

Asphalt Filler for Block Pavement—Asphalt Filler for Brick and Vitrified Pavements is the subject of the newest addition to the comprehensive set of paving booklets which have been prepared by the Asphalt Sales Department of the Texas Company. The new booklet begins its description with the arrival of the asphalt on the job in barrels and drums. Then with the aid of many illustrations it clearly and thoroughly describes each step involved in the preparation and application of asphalt filler right up to the spreading of the dressing material and the admission of traffic to the new pavement. This story of asphalt filler is presented in an attractive booklet which is small enough to tuck away in the pocket and carry about on the job. A copy may be had by addressing the Texas Company, Asphalt Sales Department, 17 Battery Place, New York City.

Street Sweeper—A new product, the "Childs" motor pick-up street sweeper, is announced in a 4-page pamphlet issued by the Foamite-Childs Corp., Utica, N. Y. This sweeper is said to be of low initial and maintenance cost, durable, of one-man convenience, quiet, dustless, with automatically self-adjusting gutter broom and standard truck parts.

Steel Bunks—A 4-page pamphlet on "Tiger" steel bunks issued by Haggard & Marcusson Co., 1109 W. 37th St., Chicago. Both single and double deck, boltless, steel bunks are illustrated.

Steel Paving Guards—Street railway paving with steel paving guards is discussed in an 8½x11-in., 12-page pamphlet, issued by W. S. Godwin Co., Inc., 12 E. Lexington St., Baltimore, Md. It is claimed that these guards guarantee perfect paving in the railway area.

Stone Pulverizer—The Jeffrey Stone Pulverizer, Tpye A, is illustrated and described in Bulletin No. 142 issued by the Jeffrey Mfg. Co., of Columbus, Ohio. This pulverizer is for making road dressing, concrete stone and agricultural limestone. The bulletin is 6x9 ins. and contains 8 pages.

Power Pumps—Power pumps for the road builder, general contractor and bridge builder are illustrated and described in a small folder issued by the Barnes Mfg. Co., Mansfield, Ohio. It is claimed that these pumps last for five years.

Pipe Couplings and Tees—A circular and price list of couplings and tees has been issued by Geo. H. Snell, Attleboro, Mass. These are the "S. & S. Easy-On" couplings and tees, designed for quick repairs to the water works distribution system.

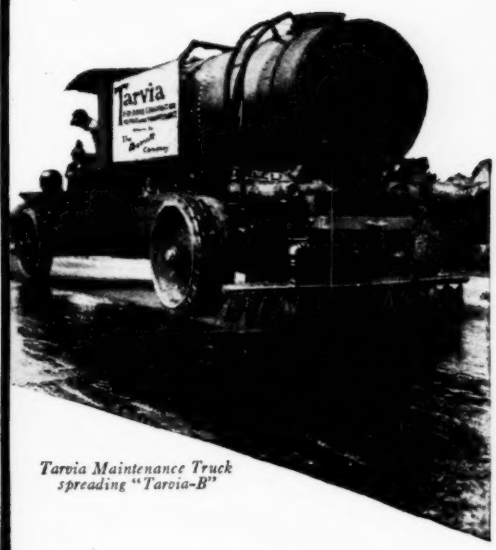
Water Testing Outfits—The W. & T. bacteriological and chemical testing outfits manufactured by Wallace & Tiernan Co., Inc., Newark, N. J., are illustrated and described in Technical Publication No. 52, issued by that Company. These outfits enable the average water works operator to make examinations of the water he supplies to the public, as often as he likes, without the services of an expert chemist.

Road Plane—The Austin Pressure Road Plane is illustrated and described in a 6x9 in. pamphlet of 16 pages issued by the Austin Manufacturing Co., Wrigley Bldg., Chicago. Special attention is given to the exclusive features of this plane. This plane is an attachment for Fordson tractors and is claimed to be the most efficient of all so-called road "finishers," "levelers" and "planers." It is designed after the principle of the carpenter's plane. Provision is made for transferring the weight of the tractor to the maintainer.

Single Stage Centrifugal Pumps—Small single-stage centrifugal pumps for motor or belt drive are described in a leaflet and in an instruction manual issued by the De Laval Steam Turbine Company, of Trenton, N. J. These pumps are made in 1½ and 2 in. sizes, and are designed for capacities ranging from 5 gals. per min. against 10 ft. head up to 130 gals. per min., against 150 ft. head. They contain few and simple parts which are manufactured to limit gages to insure interchangeability. The publications give very complete tables and instructions for selecting pumps for different conditions, and explain how to determine the proper speeds and how to select piping, valves, fittings, and driving pulley or motor to secure an efficient and satisfactory installation.

Grey Iron Street Castings—The very comprehensive line of grey iron street castings manufactured by the Wm. E. Dee Co., 30 N. La Salle St., Chicago, is illustrated and described in Catalog No. 9, recently issued. This is a catalog of 50, 4x 6½ in. pages. These are quality products, manufactured since 1855, and include

Batavia Road, Hamilton County, Ohio, "Tarvia-I" penetration in 1914. Two treatments with "Tarvia-B" practically only maintenance in 9 years.



Tarvia Maintenance Truck spreading "Tarvia-B"

Economical Construction and Economical Maintenance

What every Taxpayer desires is the *most miles* of good roads possible with the available road funds. That means economical construction *plus* economical maintenance. It means not only roads that can be built at moderate cost but roads that can be kept in good condition at small expense.

Tarvia Roads squarely meet both of these requirements.

For Tarvia Roads cost only a little more to build than plain, waterbound macadam. And with inexpensive Tarvia maintenance there is practically no limit to their life. Smooth, dustless and mudless all the year 'round, Tarvia Roads are actually improved by time and traffic. In addition to these facts the granular surface of a properly constructed and properly maintained Tarvia Road prevents skidding.

Batavia Road, Hamilton County, Ohio, shown above, is a typical example of Tarvia good-road economy. Since its construction in 1914, this road has stood up under a heavy volume of traffic. The only upkeep has been two inexpensive surface treatments with "Tarvia-B"—one in 1918; the other in 1921. Today the road is in perfect condition.

There is a grade of Tarvia for every road purpose—as a binder in new road construction; for maintaining gravel and macadam roads; for re-surfacing, patching and repairing improved roads of all types.

Tarvia
For Road Construction Repair and Maintenance

Special Service Department

This company has a corps of trained engineers, and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by anyone interested. If you will write our nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention.

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati Pittsburgh
Detroit New Orleans Birmingham Kansas City Minneapolis Dallas Salt Lake City Atlanta
Bangor Youngstown Toledo Columbus The Barrett Company Richmond Baltimore Omaha Houston
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manhole and catch basin covers, catch basin inlets, adjustable inlets, gutter boxes, gutter inlets, gutter curbs, drainage curbs, sidewalk drain curbs, cemetery frames and grates, beehive grates, coal hole cover, lamphole cover, electric light conduit frames and covers, water meter frames and covers, clean out doors and frames, salamander and boiler grates, jack screws, shock absorbers and Harvey motor trucks.

Concrete Mixer Performance—The T. L. Smith Co., of Milwaukee, recently prepared publication No. 1003 which gives interesting information on the consistent performance of Smith Pavers. Many field views are shown, complete day-by-day performance data on a trunk highway, with expressions of opinion from a number of contracting and engineering companies.

Curb Construction—A 4-page letter folder entitled "A Time Study of Curb Construction," was recently issued by the Heltzel Steel Form and Iron Co., Warren, Ohio. The folder gives a very careful comparison of wood forms versus steel forms and should be of special interest to the many contractors who are using wood forms in the South.

Drainage Pipe Discharge Diagrams—The Clay Products Association, 913 Chamber of Commerce Bldg., Chicago, recently issued a pamphlet entitled, "Run-off and Discharge Diagrams for Salt Glazed Vitrified Clay Sewer Pipe and Drain Tile." This publication will be of interest to sewerage and drainage engineers.

The Austin "Pup"—The Austin Pup, a unique development among road rollers, is described and illustrated in a 4-page pamphlet issued by the Austin-Western Road Machinery Co., 400 N. Michigan Ave., Chicago. This roller weighs only 3 tons, it is the first three-wheeled power roller weighing less than 7 tons. It is a very valuable addition to the road contractor's outfit. It is useful as a tractor as well as for rolling the subgrade. It is also a welcome substitute for traffic in compacting loose gravel and stone thrown on old road surfaces.

Rock Asphalt—Kentucky Rock Asphalt for new construction, reconstruction and maintenance is discussed in a 4x8½ in. pamphlet of 20 pages recently issued by the Kentucky Rock Asphalt Co., 711 Marion E. Taylor Bldg., Louisville, Ky. The production and use of this material is illustrated, and its advantages are enumerated. Special attention is given to the use of this material in resurfacing old roads.

Crane-Excavator—The Koehring Crane-Excavator No. 2 is illustrated and described in a 4-page pamphlet issued by the Koehring Co., of Milwaukee. The uses of this equipment in excavating and material-handling are described and its points of operating, flexibility and simplicity, are discussed.

Tar and Asphalt Heaters—Littleford Tar and Asphalt Heaters, paving tools and equipment for contractors and municipalities are illustrated and described in a 4x9 in. pamphlet of 20 pages recently issued by Littleford Bros., 406 E. Pearl St., Cincinnati, Ohio. This is a very complete line of equipment, particularly of maintenance equipment for the application of tar and asphalt. The catalog gives information pertaining to: tar and asphalt heaters, distributing tank wagons, patrol heaters, maintenance heaters, tool heaters, asphalt paving tools, tar and asphalt distributing pots and sand and gravel heaters and dryers.

Heavy Duty Pavers—The latest paver bulletin, giving views and specifications of the Koehring paver, was recently issued by the Koehring Co., of Milwaukee. This bulletin is printed on sheets 11x32 ins., but folds to 11x8 ins. This gives ample room for large, clear, detailed pictures of this line of paving mixers. Very interesting and instructive views of these mixers in operation are also shown.

De Laval Plant and Products—Under the title of, "Plant and Products," the De Laval Steam Turbine Company, of Trenton, N. J., has published a 24 page booklet briefly describing the single and multistage steam turbines, centrifugal pumps, blowers and compressors, and speed-reducing gears in which that concern has specialized since its establishment in 1901. In the present manufacturing plant, containing approximately 275,000 sq. ft. of floor space, all lines of manufacture are conducted on an interchangeable basis with limit gages throughout, including a comprehensive system of inspection, each part being marked with an identifying symbol and with an inspector's mark. The materials used are also inspected and tested and every machine when finished is subjected to a thorough performance test in order to determine efficiency and other characteristics. This policy, which has characterized the De Laval shops since their inception, has now become familiar to the general public through its adoption by leading builders of automobiles and similar appliances, and greatly promotes reliability and ease of replacement of worn or damaged parts.

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If you want to be relieved of the annoyance of extensive correspondence and calls from salesmen who do not understand your needs, just write a brief letter to us stating your requirements and we shall immediately place you in touch with the manufacturer best qualified to serve you.

Municipal and County Engineering
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Contracts Awarded

ROADS AND STREETS.

Ala., Selma—Ala. Concrete Products Co., Selma, awarded contr. by State Hwy. Dept., Montgomery, to complete 3½ miles rd. including bridges, at $100,000. Work is on Pleasant Hill, Benton Fork to Ala. River on south and from Marion Jct.—Orrville fork on west.

Cal., Los Angeles—Jahn & Bressi, 522 Byrne Bldg., 253 S. Broadway, Los Angeles, awarded contract for impvt. of Rowena Ave.—Glendale Blvd. to west line of Ivanhoe, at $222,727; Geo. H. Oswald, 366 E. 58th St., awarded contract for impvt. of 12th St.—Sentous St. to Union Ave., at $42,634.

Fla., Tallahassee—Hancock Bros., Mobile, Ala., awarded contr. by State Hwy. Dept., for grading and conc. surfacing 5-mile road from Nunez Ferry to Pensacola, Escambia Co., at $138,556; bitum. macadam surfacing 3.976 miles rd. bet. Bradentown and Sarasota Co. line, Manatee Co., to J. F. Morgan Paving Co., Woodward Bldg., Birmingham, Ala., at $154,584.

Ia., Clarion—Western Asphalt & Paving Co., Sioux City, Ia., awarded contract for paving sts. at $2.35 per sq. yd. Total, $176,000.

Ia., Clinton—McCarthy Impvt. Co., 214 W. Fourth St., Davenport, awarded contract for paving—asph. over conc. base—at $326,995.

Ind., Greensburg—Freeland & Brown, Greensburg, awarded contract for paving 60,718 sq. yds. John McCoy Rd., conc., at $172,434.

Ky., Frankfort—State Highway Department let contracts for three roads as follows: 8-mile asph. road on Jackson Hwy., Bullitt and Spencer Cos., to Wilmore Constr. Co., at $374,539 and $229,246 for 6 miles rock asph. road in Nelson Co.; 8-mile conc. rd. on Dixie Hwy. bet. Dry Ridge and Kenton Co. line, Grant Co. to Mills & Connelley, Brooksville, O., at $252,726.

Mich., Saginaw—Bennett & Crane, St. Charles, awarded contract for grading and surfacing 3.021 miles Dist. Rd. 55, waterbound macadam, at $58,-554; 4.308 mi. Dist. Rd. 56, waterbound macadam, bitum. surf. treatment, to A. Jeffrey, Saginaw, at $71,397.

Mo., Carthage—Baker & Koontz, Carthage, awarded contract to construct 2 sections of road, abt. 7 miles, at $125,000.

Mo., Jefferson City—State Hwy. Dept. let contracts for 53 rds. as follows: Pemiscot Co., 4.167 mi. conc., Lawrence Constr. Co., Jackson, Miss., at $134,856; 4.058 mi. conc., Harrison Engrg. & Constr. Co., Wichita, Kans., at $169,640; grade following: Bollinger Co. 4 sects., $23,530, 4.559 mi. $82,847; 4.955 mi., $41,923; 3.655 mi., $20,933—all to Hogan & Humphreys, Fredericktown, Mo; Callaway Co., 1.828 mi., Pittsburgh-Des Moines Steel Co., Des Moines, Ia., at $61,593; Cape Girardeau Co., 2 sects. to Muskogee Constr. Co., Tulsa, Okla., at $73,974 and $64,823 for 4.981 mi. Greene Co., 3 sects. 3.551 to V. E. Koch, Joplin, Mo., at $38,074; 4.069 mi. to Republic Constr. Co., Republic, Mo., at $90,685; 2.954 mi. to M. E. Gillioz, Monett, Mo., at $29,368; Jefferson Co., 3 sects. to Louis Rich Constr. Co., E. St. Louis, Ill., at $79,122, $100,526, $61,279; 2.868 mi., at $61,279; Laclede Co. 2 sects. Davis Constr. Co. Mammoth Springs, Ark., at $53,775; 2.327 mi. Davis Constr. Co., $53,775; 2.327 mi. to M. E. Gillioz, at $30,017; Madison Co., 2 sects. to J. H. Hewett, Little Rock, Ark.; 4.996 mi. at $58,201; 4.950 mi. at $39,-727; Phelps Co., 3 sects. to M. E. Gillioz, at $15,-790; 3.161 mi. to Ramsey & Davis, Caruthersville, Mo., at $86,343; 4.997 mi. to M. E. Gillioz, at $34,-400; Pulaski Co., 3 sects. 4.943 mi. to O. F. Nicholso Laquey, Mo., at $31,843; 2.032 mi., to Miller Constr. Co., Springfield, Mo., at $50,895 and at $83,304, for 3.985 mi., Saline Co., 5 sects. to Cook-O'Brien Constr. Co., Kans. City, Mo.; 4.799 mi., at $62,222; 5 mi. at $143,747; 4.973 mi. at $58,933; 4.987 mi. at $65,646; 4.744 mi. at $20,605. Following hard surf. type: Green Co., 1.398 mi. conc. to Springfield Constr. Co., at $44,027; Dent Co., 2 sects. 4.261 mi. gravel, at $14,928; 4.856 mi. gravel, at $24,427; Franklin Co., 4.820 mi. gravel, to Allhands & Davis, at $30,946; Texas Co. to Summerfield—Jones Co., Springfield, Mo.; 5 mi. gravel, at $15,731; 5 mi. gravel, $14,697; Oregon Co., 1.638 mi. gravel, Sec. 102, to Summerfield-Jones, at $7,975. Earth roads: Andrew Co., 2.447 mi. to Somers-Hall Constr. Co., Newton, Kans., at $25,441; Barton Co., .360 mi. to J. H. Clark, Nevada, Mo., at $13,679; Carroll Co., 3.561 mi. to Cameron-Joyce & Co., Keokuk, Ia., at $77,591; Gentry Co., 2 sects. to W. J. Welch, Genoa, Neb.; .848 mi., at $17,534; .440 mi. at $6,705; Greene Co., .636 mi. to V. E. Koch, at $11,289; Holt Co., 2.428 mi. to Somers-Hall Constr. Co., at $37,311; McDonald Co. 3.143 mi. to J. H. Roach & Co., Anderson, Mo., at $38,868; Mercer Co., 2 sects. to Mike Haase, Trenton, Mo.; 2.476 mi. at $9,009; 2.695 mi., at $13,613; Newton Co., 4.871 mi. to J. P. Wolfenbarger, Neosho, Mo., at $64,688; Nodaway Co., 2 sects. to A. L. Cook, Ottawa, Kans., 2.727 mi. at $19,377; 2.268 mi. at $13,017; Schuyler Co., 4.115 mi. to Cameron, Joyce & Co., at $22,293; Washington Co., 3.846 mi. to St. Louis Constr. Co., St. Louis, Mo., at $55,321; Clay Co., work awarded to Highway Constr. Co., Webb City, Mo., at $88,000.

N. Y., Albany—M. F. Dollard, 36 State St., award. contract by Bd. Contr. & Supply, for paving Madison Ave., at $355,580.

N. Y., Albion—Orleans Co. will construct 1¾ mi. rd. in Yates, 1½ mi. in Shelby, 1½ mi. in Carleton, 1½ mi. Clarendon, 2½ mi. Barre, 2 3/5 mi. Ridgeway by day labor—all bitum. macadam. Supervision of H. D. Waldo, Co. Supt. Est. cost $143,-250.

N. C., Asheville—Asheville Paving Co. award. contracts at $200,000 for asph. paving and to E. T. Belote for conc. paving; both Asheville; 11,000 yds. sheet asph., 8,500 yds. Willite bitulithic; 8,300 yds. asph. conc., and 40,000 yds. conc.

N. C., Greensboro—Murray Constr. Co., Holston Bank Bldg., Knoxville, Tenn., awarded contract for paving 12 miles various streets, concrete; sheet asph. and bitum. conc., at $591,720.

N. C., Leaksville—Hedrick Constr. Co., Lexington, N. C., awarded contract for street paving at $189,744.

N. C., Raleigh—State Hwy. Comn. let contracts for 22 roads as follows: 115—Chowan-Perquimans Cos., 11.38 mi. hard surf. to Smith Bros., Inc., at $282,411, for roadway and Public Service Production Co., at $14,224 for structs.; 146—Hertford-Bertie Cos., 6.42 mi. from Aulander to Northampton Co. line to Nello L. Teer, at $31,561 for rdway; Atlantic Bridge Co., Charlotte, N. C., at $21,820 for structs.; 151—B. Hyde Co., grade 4.39 mi. to Porter & Peck, Greenville, N. C., at $48,740; 213—Craven Co., 10.43 miles hard surf. to Union Paving Co., at $356,879 for rdway and at $52,294 for structs.; 293—Wilson, 9 miles hard. surf. to Public Service Co., at $321,305 for roadway and $36,447 for structs.; 392—Robeson Co., 1.06 mi. hard surf. to Robeson Rd. Commissioners, at $22,405, and E. T. Gwathmey, at $52,648 for structs.; 329—Columbus Co., 12.89 mi. hard surf. to Jas. O. Heyworth, at $365,013; 408—Durham Co., .47 mi. on Central Hwy. to C. D. Rigsbee, Durham, at $16,270; 437—Hartnett Co., 10.47 mi. gravel from Lillington to Duke, to E. P. Holder, at $50,727, and T. J. Newell, at $40,646 for structs.; 457—A, Orange Co., 7.45 mi. gravel to Dicus Bros., at $50,107 for roadway and to Richards Bros., at $17,693 for structs.; 485—A, Wake

Co., 7.81 miles soil bet. Neuse River & Franklin Co. line, to C. G. Hershaw, at $36,788 for roadway structs.; 578—Randolph Co., 7.97 miles hard surf. to and T. P. Newell at $47,706 for structs.; 570—Moore Co., 22.10 mi. soil bet. Aberdeen and Montgomery Co. line, to L. M. Loudermilk at $71,203 for roadway and to Mayfield Constr. Co., at $25,100 for Allport Constr. Co., Asheville, N. C., at $279,931; 616—Cabarrus Co., 8.59 mi. gravel on Cabarrus-Albemarle Hwy. to Lee J. Smith, Charlotte, at $40,557 for roadway and W. M. Lefler at $67,409 for structs.; 643—Iredell Co., 8.57 mi. hard surf. to Searnes Bros., Statesville, N. C., at $292,377; 713—A. Ashe Co., 3.53 mi. hard surf. to Overstreet and Nance, at $132,530; 723—Caldwell Co., 3.54 mi. penetration macad. to W. H. Anderson Constr. Co., Spruce Pine, N. C., at $130,529; 835—Henderson Co., 6.97 mi. hard surf. on W. C. A. Hwy., to J. B. Ross, Jr., at $183,703 and to R. G. Stevens, Asheville, at $67,206; 944—Haywood Co., 11.66 mi. hard surf. bet. Waynesville and Canton, to A. J. Waldrep at $351,244; and to J. A. Kries at $20,168 for structs.; 961—A. Ext. Macon Co., 8.27 mi. hard surf. from end of Proj. 960 to Tenn. line, to Luten Bridge Co., Charlotte, at $11,845; 971—Madison Co., 6.74 mi. penetration macadam bet. Hot Sprgs. and Tenn. line, to Reynolds Constr. Co., at $96,758 for roadway and to J. A. Kries, at $62,094.

N. C., Rockingham—Hedrick Constr. Co., Rockingham, awarded contract for grading and paving various streets at $100,000.

N. C., Winston Salem—City contemplates expending $917,137 to pave about 50 streets and total expendt. of $1,501,939 which includes paving, grading, curbing, sewer, water connections and extensions, brdgs., culverts, etc. Powell Paving Co. will pave 13 streets with asph. and bitulithic; Atlantic Bitulithic Co. will pave remainder with bitulithic and Kentucky rock asphalt.

Okla., Okla. City—State Highway Dept. let contracts to construct 8 road projects as follows: 15, Washington Co., 6.114 miles 2-in. Willite surf. on 3-in. Willite base to Hamilton Construction Co., Bartlesville, Okla., at $210,031; 68, Johnston Co., 14.870 mi. gravel rd. to Garrett & Mills Co., Okla. City, at $99,602, brdgs. to General Construction Co., St. Louis, at $74,227; 67, Johnston Co., 4.052 mi. gravel rd. to Madill Construction Co., Madill, Okla., at $44,184; 69, Pittsburgh Co., 7.419 miles 2-in. Willite surf. on 3-in. Willite base, to Western Paving Co., Okla. City, at $243,397; 80, Pittsburgh Co., 5.663 mi. 2-in. Willite surf. on 3-in. Willite base to Western Paving Co., at $177,680; 81, Pittsburgh Co., 3.839 miles Bates type conc. pavement to Green Constr. Co., Okla. City, at $126,252; 88, Creek Co., 1.65 miles 2-in. Willite surface on 3-in. Willite base to A. O. Bowers, Okla. City, at $50,921; 89, Carter Co., 2.925 mi. 1½-in. Willite surf. on 3½-in. Willite base to General Construction Co., St. Louis, Mo., at $80,266.

S. C., Easley—Carolina Contracting Co., Spartanburg, S. C., award. contract to pave and lay sidewalks on certain streets, at $100,000.

S. C., Camden—Southern Paving Co., Camden, awarded contract for 100,000 sq. yds. asph., at $300,000.

S. D., Aberdeen—Vernon W. O'Connor, 1335 Summit Ave., St. Paul, Minn., awarded contract for paving streets, at $29,672. Vibrolithic paving.

Tex., Corpus Christi—Smith Bros., 308 Sumpter Bldg., Dallas, awarded contract by Nueces Co., for surfacing with 1-in. cold natural rock asph. topping 10.97 mi. Corpus Christi-Robstown Hwy.; also 11.17 miles State Hwy. 12, at $332,707.

Tex., Eldorado—Rice & Bates, Austin, awarded contract for grading, gravel surfacing on crushed stone and bitum. topping 9.86 miles State Hwy. 4, 16 ft. at $112,617 (Schleicher County).

Tex., Rockwall—McCollum Constr. Co., 1507 F. & M. Bldg., Ft. Worth, awarded contract for 57,000 sq. yds. conc. pavement on Rockwell-Chrisholm Rd. from Rockwall to Kaufman Co. line, at $143,772.

Va., Richmond—State Hwy. Comn. let contracts to construct 2 roads as following: 6.13 miles bitum. macad. rd., Hecklenburg Co., to Smith Bros., Dallas, Tex., at $169,079; 7.86 miles conc. rd. in Nansemond Co., to Harrison Engineering & Constr. Co., Buffalo, N. Y., at $290,645; also contracts for 2 bridges as follows: 178-ft. bridge over Clinch River to Lilly & Baldwin, Bluefield, W. Va., at $16,586; 38½-ft. brdg. over Pounding Hill branch, to Luten Bridge Co., Knoxville, Tenn., at $4,857.

Wash., Olympia—Jos. Warter, Sr., Tacoma, awarded contract by State Hwy. Comn., for 5.3 mi. impvt. on Pacific Hwy., from Kelso so. to Stockport, at $171,951; also 4.6 miles Pacific Hwy., Stockport so. to Castle Rock, at $148,435. Impvt. calls for 6½-in. conc. pavement 20 ft. in width.

Wash., Seattle—McHugh Construction Co., 517 3rd Ave., north, Seattle, awarded contract by State Highway Comn., for grading, draining and paving with conc. abt. 4.71 miles Pacific Hwy. bet. Castle Rock and Laughlin's in Cowlitz Co., at $147,559; grading, draining and paving with concrete about 5.53 mi. Pacific Hwy. bet. Laughlin's and Neal's, Cowlitz and Lewis Cos., at $180,111.

Wash., Spokane—J. E. Edwards & Mohf Constr. Co., Spokane, award. contracts for constr. of 16 miles new county highway, at something over $160,000.

W. Va., Morgantown—Willite Co., (of W. Va.) awarded contract to pave 3 miles of streets at $159,170.

W. Va., Wayne—White & Rich Contg. Co., Williamson, awarded contr. for 6½ miles Tug River Hwy., Lincoln Dist., at $143,124.

Wis., Jefferson—Jefferson County State Rd. & Bridge Comn., Ionia-Watertown Rd., to McGucken Constr. Co., 425 East Water St., Milwaukee, at $95,789; Whitewater-Ft. Atkinson Rd., to J. P. Connell, Janesville, at $140,670; Ft. Atkinson-Cambridge Rd. to F. Doherty, 753 47th St., Milwaukee, at $191,110.

Wis., La Crosse—T. E. Woolley, 148 West Ave. so., awarded contr. for brick paving 25,000 sq. yds. on various streets, at $104,837.

SEWERAGE AND SEWAGE TREATMENT.

Cal., Alhambra—Hickey & Harmon, San Diego, awarded contract for constr. of Div. 1 (San Marino outfall) and Divs. 2, 3, 4 and 5 of new city sewer system. Total alt. No. 1, $123,806; alt. No. 2, $118,939. Bid on Div. 1, $20,064.25.

Cal., Los Angeles—S. Zarubica, 3006 6th Ave., awarded contract for constr. of sewer in Ambrose Ave., Dracena Dr. to 121 ft. east from Vermont Ave., at $3,050; J. M. Derenia, 237 W. 83rd St., awarded contract for constr. of sewer in Huntington Dr. so., bet. Lomitas Dr. and Topaz St., at $3,050; J. M. Derenia, 237 W. 83rd St., awarded contract for constr. of sewer in Agate St.—Johnston to Montecito Sts.—at $4,954; C. E. Green, 230 Grosse Bldg., awarded contract for constr. of Sec. 5 of tem. outfall sewer bet. Figueroa St. and Overland Ave., brk. conc. sewer, at $84,000.

Cal., Los Angeles—C. E. Green, 230 Grosse Bldg., awarded contract for constr. of sewer in Fallston Ct., at $28,542; Croatian-American Inv. Co., 208 W. 2nd St., awarded contr. for constr. of sewer in Rimpau Blvd., at $25,900; P. J. Akmadzich, 821 Yale St., awarded contr. for constr. of conc. walks in Ellsworth St., at $1,394.

Ont., Toronto—J. O. Jerou, 90 Curzon St., award. contract for 10,000 ft. brk. and tile relief sewer in Roncesvallves Aves., at $130,807.

D. C., Washington—Following contracts let for sewer construction in District: Warren F. Brenizer at $23,927 for relief sewer on I St., between 20th and 21st, N. W., and at $9,740 for service sewer on Conduit Rd. at Little Falls Rd. and Jewett St., N. W.; Adams McCandlish at $2,274 for storm sewer on McKinley St.—Nevada Ave. to 37th St. N. W., and at $4,240 for sewer on Brooks St.—44th to 47th Sts. N. W.

Ill., Bellewood—Kruse Constr. Co., Marion City, Ia., awarded contr. for sewers and water mains, at $59,000.

Ill., Chicago—J. Titiyilli, 910 Laflin St.; M. Pontarelli, 4838 Dakin St. and O. Scully, 1654 W. 69th St. awarded contracts by Bd. Local Impvts., for sewers in various streets, at total cost of $138,096.

Ill., Genesco—National Constr. Co., Davenport, Iowa, awarded contract for construction of san. and storm drain system, at $166,000. 12 miles of streets.

Ia., Bedford—Royer-Craig Co., 1322 32nd St., Des Moines, awarded contract for san. sewerage system at $31,932.

Kans., Wichita—Foster & Skaer, Wichita, award.

contract for 1,970 lin. ft. 10-in. sewer pipe, $0.99, 4,100 lin. ft. 8-in., $$0.78, 2,300 lin. ft. 8-in., $0.85, 2,650 lin. ft. 8-in., $0.82, 33 manholes, $55.50, 10 manholes, No. 39; 12 manholes, $55; Municipal Excavator Co., 200 E. Main St., Okla. City, Okla., 350 lin. ft. 18-in., $2.18; 200 lin. ft. 15-in., $1.78; 450 lin. ft. 12-in., $1.49; 2,600 lin. ft. 8-in., $0.85; 160 lin. ft. 18-in., $2.22; 3 manholes, $65, 10 manholes, $66, 7 comb. manholes and catch basins, $75; H. L. Niles, 331½ E. Douglas St., 350 lin. ft. 12-in. pipe, $1.56; 3 manholes, $45; 12 san. sewer connections, $5; F. C. Kensler, 1558 S. Water St. 1,562 lin. ft. comb. curb. & gutter, $0.84; F. T. Newell, 2198 sq. yds. excav. at $0.57.

Mass., Boston—Jno. W. O'Connell awarded contract for sewerage works in Hanover St., at $8,227; Samuel J. Tomasello, awarded contract for sewerage works in portion of Mass. Ave., at $8,405; R. Zoppo, contr. for sewerage works in Milton St.—Wordsworth to 100 ft. easterly, at $741.

Mich., Pleasant Ridge—G. Ponterilli, Wolverine Hotel, Detroit, awarded contract for 24,400 ft. 12-66 in. vit. crock. conc. or segment blk. sewers at $156,446.

Mich., Royal Oak—R. D. Baker & Co., 1631 Elmhurst Ave., Detroit, awarded contract for 3rd section of main trunk san. sewer, 13,430 ft. 10-30 in. vit. pipe, at $92,000.

Mich., Springwells—Detroit Drainage Constr. Co., 5099 Lemay Ave., Detroit, for constructing 1,348 ft. 66-in. and 2,280 ft. 60-in. brick or monolithic conc. sewer in Greenfield Blvd. and Rome Ave., at $63,155.

Minn., Lake City—Christensen & Axelsen, Clear Lake, Iowa, awarded for san. sewerage system; 59,303 lin. ft. 8-18 in. sewer pipe, manholes, flush tanks, etc.; 6,600 lin. ft. 8-12 in. storm sewers, 11 manholes, 65 storm water inlets, etc., at $99,080.

Mont., Shelby—Two Miracle Concrete Co., Great Falls, awarded contract for extension of sewers and water mains; also 60 blks. concrete walks at total cost of $120,000.

N. J., Newark—H. L. Harrison, 31 Clinton St., awarded contr. for Union Outlet sewer connections, at $35,600.

N. Y., Binghamton—G. D'Angelo, Binghamton, awarded contract for 18,000 ft. 27-in. sewer in Leroy St., at $46,500.

N. Y., Blasdell—G. Moore, 82 Ridgefield Ave., Buffalo, awarded contract for sewage disposal plant, at $63,557; J. W. Erwin, Greenville, Ohio, awarded contract for sewerage system at $89,391.

N. Y., Buffalo—Contract let to J. M. Fahning, 460 Leroy Ave., 10-in. tile sewer in Gratiot Ave., at $4,941; 10-24 in. in Lenox Ave., $32,418, 10-15 in. in E. Hertel Ave., $2,500 and Hertel Ave. Part 2, $1,783; to Dark & Co., 654 Main St., 36 in. in Hewitt Ave., $9,663, 27-in. in Hewitt Ave., abt. $8,780 to L. DiPasquale, 126 Erie St., 10-21 in. sewer in Parkridge Ave. $5,315; 10-in. tile Eagles St., at $1,355.

N. Y., Long Island City—Booth & Flinn, Ltd. Green & Tompkins Aves., Brooklyn, awarded contr. for storm water sewer in 25th St., Riker to Ditmars Ave., at $528,002.

N. Y., New York—J. L. Sigretto, Woodhaven, awarded contract for sewers in Strang, Pilgrim, Theriot and Taylor Aves., at $134,943, $17,518, $11,-163, and $9,630, respectively; Mayflower Ave. to W. McDonald, W. 10th St., Brooklyn, at $56,492; Cruger & Mace Aves, to J. V. Timoney Co., 220 W. 201st St., at $12,991 and $1,672 respectively; Roebling Ave., to Knight & Demicco, 448 E. Tremont Ave., at $8,525; Orloff Ave. and Burnett Pl. to Gregorio & Gabriele, 1129 8th Ave., at $10,490 and $4,340.

N. Y., Spring Valley—B. Pizzimenti, Harrison, awarded contract for constr. of sewers and sewage disposal plant, at $219,018.

O., Ashtabula—C. Hukari, Ashtabula, awarded contract for East Side sewer, 8,000 ft. 15-27 in. vit. clay and 2,000 ft. 42-in. segmental blk. at $116.744.

Ohio, Toledo—Harris & Tansey, 504 Nasby Bldg., awarded contr. for monolithic conc. West Side and Swan Creek intercepting sewer, Cont. 6, at $500,253.

Pa., Natrona—S. Baumgardner, Orchard Ave., Bellevue (Pittsburgh, P. O.) awarded contract for 5 miles 24-in. terra cotta sewers, at $59,700.

Tex., Big Springs—Janes Contracting Co., Dallas, awarded contract to construct approx. 5 miles extension, at $40,500.

Utah, Ogden—W. E. Roche, Ogden, awarded contract for 18,019 ft. 8 24 in. conc. san. sewers in Dist. 149, and 21,429 8-15 in. conc. sewers in Dist. 148, at $74,236 and $68,763 respectively.

Wis., Milwaukee—Wenzel & Henoch Co., 498 27th St., awarded contr. for East high level sewer, Sec. 1, at $495,468; A. H. Prange, 101 Campeau Ave., Grand Rapids, Mich., awarded contract by Met. Sewerage Comn., for main sewer, Sec. 2; 9,060 ft. 36-in. conc. pipe in tunnel, at $317,425.

Wis., Milwaukee—Knowles & Fehr, Inc., 314 N. Dearborn St., Chicago, awarded contract for 10,425 ft. sewers Sec. 1, 1st, Austin, Cora and Clement Aves., at $330,728.

WATER SUPPLY AND PURIFICATION.

Colo., Grand Jct.—Orman Constr. Co., Pueblo, awarded contract for concrete reservoir, 13,500,000 gals., at $97,722.

Md., Baltimore—Carozza-Rowe Constr. Co., 624 Gilmor St., awarded contract by Bd. of Awards, addn. to Montebello filtration plant, Contr. 63: 365,-000 c.y. excav. 74,000 c.y. rolled embankment, 45,400 c.y. conc., 3,760,000 lbs. steel reinforcing, 800 tons setting c.i. pipes, valves and sluice gates, at $1,-070,000.

Mass., Boston—C & R Constr. Co., 3 Tremont Row, awarded contr. for 9,565 ft. 8-16 in. cast iron mains in Bedford, Boyleston, South, Franklin, Broad, High, Hawley, Oliver and Beach Sts., at $133,248.

Mass., Boston—L. Balboni awarded contract for laying and relaying water pipes in Bellevue Ave., and other thoroughfares, at $1,361.50.

Minn., Lake City—Litchfield Drainage & Constr. Co., Litchfield, awarded contract for 33,880 lin. ft. 6-in. and 768 lin. ft. 4-in. mains; 64 4-in. and one 5-in. hydrants; 47 6-in. valves and boxes, 18,000 lbs. specials, 29 connections to present mains, at $58,943.

Mont., Shelby—Two Miracle Co., Ford Bldg., Great Falls, awarded contract for 15,000 ft. 6-in. and 4,000 ft. 4-in. cast iron mains, at $$62,185.

Neb., Davenport—Chas. Roebeck, 1557 Park Ave., Omaha, awarded contract for water works system at $26,000.

N. Y., Brooklyn—Bd. Water Supply, New York awarded contract for Narrow Siphon 2, portion Catskill Aqueduct extending across N. Y. harbor from 8th St. and Shore Rd., Bay Ridge here to Vanderbilt Ave., and Bay St., Clifton, Staten Island, to Merritt, Chapman & Scott Corp., 17 Battery Pl., New York, at $1,523,136; Park Slope & Ft. Hamilton conduits portion of city conduits of Catskill Aqued., extending from Shaft 23 of city tunnel at Schermerhorn St. & 3rd Ave., etc. to T. A. Gillespie Co., 7 Dey St., New York, at $2,338,-805.

N. Y., Scottsville—Pittsburgh-Des Moines Co., Curry Bldg., Pittsburgh awarded contract for new water works system, at $60,000.

N. C., Fayetteville—City let following contract for extension of water and sewerage system to cost approx. $300,000: Tucker & Laxton, Charlotte, construct sewerage system at $150,000; Chicago Bridge & Iron Works, contract to construct elevated steel water tank; Fayetteville Supply Co. to install motor-driven centrif. pump; Palmer & Conrad, Florence, S. C. contr. for constructing rein. conc. reservoir; Glamorgan Pipe & Foundry Co., Lynchburg, Va., fire hydrants and valves for water distribution system.

N. C., Roxboro—Boyd, Higgins & Goforth, Inc., Realty Bldg., Charlotte, awarded contract for laying 20,000 ft. 12-in. pipe, conc. and brick filter plant and pumpg. sta., conc. reservoir, one 500 G. P. M. centrif. pump, elec. motor, one 500 gal. centrif. pump, gas engine driven, at $92,572.

Ohio, Delaware—Heine Safety Boiler Co., 1432 Union Trust Bldg., Cincinnati, awarded contract for two 200 h.p. boilers at Girls' Industrial Home, Concord, Delaware County near here, at $14,230; Factory Engineers & Sales Co., Commerce Bldg., Columbus, contr. for filtered water pump, at $2,119.

Tex., Beaumont—U. S. Cast Iron Pipe Co., Am. Trust Bldg., Birmingham, Ala., awarded contract for 4 24-in. cast iron pipe, at $52 per ton—total, $50,000.

Tex., Ft. Worth—American Cast Iron Pipe Co., Acipco, Birmingham, Ala., awarded contract for 6 20-in. cast iron pipe, at $52 per ton or total of $400,000.

Tex., Shamrock—R. M. Irick & Son, Plainview,

awarded contract for gravity pipe line and reservoir, at $98,670.

Wash., Everett—T. M. Morgan, Everett, awarded contract for 20,000,000 gal. reservoir, 400 ft. sq. basin, conc. lined, etc., at $150,635.

W. Va., Wheeling—City Mgr. C. H. Dowler has approved recommendations of the J. N. Chester Engrs., Inc., relative to awarding contracts for constr. of filtr. plants on Garden site at Warwood. $2,000,000 available. Contracts recommended are as follows: No. 2, intake pier suction pipe and tunnel, at $82,500, to Jno. P. Casey Co. and Cont. 3, for r. r. siding, excavation and conc. work at $399,000; No. 4, superstructs., pump station and filter plant to Engstrom & Knapp, at $184,130; No. 5, elevators for filter plant and pump sta., to Otis Elevator Co., at $11,760; Contr. 7—boilers for heating sys., at $4,240 to Bartley O'Neil & Co.; No. 8, pump. sta. piping at $33,000 to Pitt Constr. Co.; No. 9, filter equipment at $93,710 to M. L. Bayard & Co.; No. 10, steel filter wash tank at $9,500 to Chicago Brdg. & Iron Co.; No. 11, filter plant conveyor sys. at $9,470 to Stephens-Adamson Co.; No. 12, excav. and foundation for reservoir tanks at $42,990 to Pittsburgh-Des Moines Steel Co.; and following contracts, 13—reservoir tanks at $93,080, 14—force mains at $311,850; 22—laying force mains, Out-the-Pike from Fulton to Elm Grove, the Greggsville and Mt. De Chantal extensions at $125,005; No. 23—laying mains in Warwood at $8,400; No. 15—cast iron pipe at $119,907 to U. S. Cast Iron Pipe & Foundry Co., Burlington, N. J.; 16 gate valves for mains, pumping and filter plant at $$40,-762 to Ludlow Valve Mfg. Co., also 18 air relief valves at $1,102.50; 17 check valves for pumping sta., at $44,162 to Michigan Valve & Foundry Co., 19—Hydraulic plug valves for filter plant to Michigan Valve & Foundry Co.; 21—sluice gates for intake and filter plant at $6,449 to Caldwell-Wilcox Co.

Wis., Milwaukee—P. Riesens Sons, 1018 Humboldt Ave., awarded contract for Riverside pumping sta., 130x240 ft., 56 ft. high, brick, concrete and steel, ft. Chambers St., at $434,791.

Prospective Work

ROADS AND STREETS.

Ala., Jasper—Walker County plans to expend $120,000 for 10 miles road in county.

Ark., Newport—Morgan Engineering Co., Memphis, have been retained for engineering work in connection with 20 blocks of street paving here.

Ariz., Tucson—Nelson Davenport, Co. Hwy. Engr., states that constr. of the 16-mile Ajo-Gila Bend hwy., will be started as soon as arrangements can be completed. Plans for impvt. of hwy. bet. Ajo and Sonoita on the border, about 40 miles, will be started by Hwy. Comn. after July 1st.

Cal., Bakersfield—Engr. Paul Kressly, 732 H. W. Hellman Bldg., Los Angeles, appointed by Co. Supvrs. to prepare plans and specfs. for Willite paving approx. 20 miles hwy. in Arvin and Weed Patch Dists., R. D. I. No. 24, near Bakersfield. Resolution of intention adopted.

Cal., San Diego—City Engineer G. A. Rhodes has in preparation plans for about 25 miles city street paving here. Est. cost $2,000,000. Approx. 18 miles new water mains will be laid.

Cal., Santa Barbara—Co. Surv., Owen H. O'Neill, has been instructed to prepare plans and specfs., for permanent rd. div. in Santa Ynez Valley. This is first step toward paving 25 miles of hwy. in this territory. Petitioners ask for 18-ft. oiled macadam roads. Road will connect with San Marcos rd. and run through Solvang, Janin's Cor., Ballard, Los Olivois and Zaca Sta. Proj. will amount to approx. $1,000,000. Dist. represented embraces 400,-000 acres.

Cal., Santa Barbara—Sam J. Stanwood, Co. Supervisor, reports that Rattlesnake Canyon Rd.—Mission Canyon to city limits—also Mission Canyon Rd. for a quarter of a mile, will be paved at once. Total impvt. will consist of about 1 mile of 6-in. macadam paving. City Council has decided to purchase new street sweeping equipment. Fred Johnson, City Manager.

Fla., Bradentown—E. P. Green, mayor, plans to expend $100,000 for street extension. Kirby & Myler, Engrs.

Fla., W. Palm Beach—Palm Beach Co. Commrs. Dist. 15, plans to extend Ocean Blvd., Boca Ratone to county border, complete W. Boynton Rd. and construct bridge at Lantana. $55,000 bonds voted.

Fla., Winter Park—City plans to construct 5½ miles brick roads within city limits.

Ga., Waycross—State Hwy. Dept., Atlanta, Ga., considering bldg. 3 roads in Ware County: Waycross-Manor, $100,000; Iron bridge, $126,000; Waresboro, $90,000; also Satilla River brdg. on Waycross-Blackshear Rd., $93,000. H. M. Pafford, State Hwy. Engr.

Ind., Indianapolis—Paving program of State Highway Commission for 1923, 1924 and 1925 is as follows: 1923: Mich. City, east 13.3 miles (Boot Jack rd.); So. Bend, so. 10.5 miles, No. 1; Ft. Wayne, west 12.6 mi. on Lincoln Hwy., No. 2; Evansville, no. 8.6 mi. Rd. 10; Evansville, east 6.4 mi. Rd. 4; Haysville to Crystal, 8.8 mi., Rd. 4; Indianapolis to Lebanon, 13.8 mi., Rd. 6; Carmel to Kokomo, 12.1 mi. Rd. 1; Carmel to Kokomo, 11.7 mi., Rd. 1; Ft. Wayne, east 12.6 mi., Lincoln Hwy. No. 2; Angola, west 9.8 mi. Rd. 25; Seymour-Scottsburg, 16.4 mi. Rd. 1; Terre Haute-Farmersburg, 12 mi. Rd. 10; Reelsville, 1.5 mi., National Rd.; Terre Haute, W. Terre Haute, 2.5 mi., Rd. 3. Total—152.9 miles. 1924: Lagrange-Middlebury, 26.5 mi. Rd. 25; Indianapolis-Anderson, 20 mi., Pendleton pike; Anderson-Alexandria, 3.5 mi., Rd. 11; Anderson-Muncie, 16 mi., Rd. 37; Ft. Wayne-Plymouth, 60 miles, Rd. 44; Indianapolis-Shelbyville, 18 mi., Rd. 6; Indianapolis south, 25 miles, Bluff Rd.; Indianapolis-Lafayette, 45, Rd. 6; Vedeersburg-Lyford, 30 miles, Rd. 9; Boswell-Chicago, 80 mi., Rd. 9; Scottsburg, so. 25 mi., Rd. 1; French Lick-Crystal, 6.5 mi., Rd. 4; Hazleton, so. 15 miles, Rd. 10; Sullivan, no., 10 miles, Rd. 10; Dale-Friendship, 10 miles, Rd. 4. Total—405.5 miles. 1925: Sullivan-Hazleton, 45 mi., Rd. 10; Peru-Plymouth, 40 mi. Rd. 1; Terre Haute-Lyford, 15 mi., Rd. 10; Veedersburg-Boswell, 34 mi., Rd. 9; Lafayette-Fowler, 30 mi. Rd. 6; Valparaiso-Plymouth, 40 mi., Rd. 44; Franklin-Columbus, 20 mi., Rd. 1; Angola, east 10 mi., Rd. 25; Middlebury, west, 10 mi., Rd. 25; Ligonier-Churubusco, 15 mi. Rd. 2; Martinsville-Bloomington, 12 mi., Rd. 22; Muncie-Portland, 30 mi.; Connersville-Cambridge, 13 mi., Rd. 34; Jasper-Haysville, 10 mi. Rd. 4; Ft. Wayne-Alexandria, 52 mi. Rd. 11; Lagrange, east, 12 mi. Rd. 25. Total—399.5 miles.

Ia., Council Bluffs—City considering resurfacing five streets; 50,000 c.y. various types. E. E. Spetman, Engr., Council Bluffs. O. Hochman, City Clerk.

Ky., Frankfort—City contemplates paving Main St.—High to St. Clair; St. Clair—Broadway to brdg. on Bridge St.; 2nd—Bridge to Capitol Ave., Annex from Main to Broadway and Elk Alley—Main to L. & N. Sta.; all 6-in. conc. base with 3-in. sheet asph. surface—$101,000.

Ky., Georgetown—$300,000 bonds voted by Scott Co. for impvt. of roads and highways.

Ky., Pikeville—Pike Councy Fiscal Court—W. E. Flannery, Co. Judge—plans to expend $350,000 for road construction; including bldg. Bent Branch mtn. rd., to connect Pikesville-Williamson rd., with Brushy Gap rd. and 3 miles up Coon Creek to connect with Pikesville-Williamson rd. at mouth of Burning Fork.

Mich., Battle Creek—City will expend $107,220 for paving, sidewalk constr. and curbing during coming year, according to program of Dept. of Pub. Wks., submitted to City Comn. by Commr. A. Fred Larmour. City contemplates spending $28,-100 for new sidewalks, according to the program. Petition filed with Calhoun County Rd. Commrs. to build 2½ mi. pavement under Covert Act from end of Prairies Ave. road out of Battle Creek so. in Leroy Twp. It is known as the Stone Jug Rd.

Minn., Willmar—Kandiyohi County will gravel 70 miles of roads in County. Samuel Nelson, Co. Aud.

Miss., Water Valley—Yalebusha Co. Commrs. considering hard surfacing 23 miles Jeff Davis Hwy. thru Lalobusha Co. from Grenada Co. line to

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Air Lift Pumps.
Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Chausse Oil Burner Co.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Chausse Oil Burner Co.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Chausse Oil Burner Co.
Littleford Brothers.

Auto Fire Apparatus.
Kissel Motor Car Co.
International Motor Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling & Harnischfeger.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
E. I. du Pont de Nemours & Co., Inc.

Bodies.
Lee Trailer and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling & Harnischfeger.

Buckets, Dumping.
Littleford Brothers.
Pawling & Harnischfeger.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Central Heating Plants.
American District Steam Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L., The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Carey Co., Philip, The.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Consulting Engineers.
Alvord, John W.
Artingstall, Wm.
Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Hill, Nicholas S., Jr.,
Howard, J. W.
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Luten, Daniel B.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L., The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Austin-Western Road Machinery Co.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Direct Oxidation Process.
Direct Oxidation Process Corp.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg Co., W. E.

Drawing Materials.
Kolesch & Co.

Dryers.
Cummer & Son., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

Lafayette Co. line. Est. cost $217,500. Fed Govt. will furnish equal amount.

Mo., St. Louis—Henry Keil, mayor, plans to improve 12th St. City will pay $350,000; remainder to be paid by special taxes.

Mont., Great Falls—Principal project in Cascade County's 1923 road bldg. campaign will be constr. of a surfaced hwy. bet. Ulm and Cascade, covering 14 miles. Bonds have been voted and $50,000 set aside for the impvt. This sum, representing 47 per cent of the cost of the highway, will be matched with 53 per cent of the cost of the road by Fed. Govt.

N. H., Concord—State Hwy. Comn., has appropriated $1,033,500 for road work, including $28,588 for Pinkham Notch Rd., and $30,000 for bridges on same; also $1,466,500 for road maintenance. F. E. Everett, State Hwy. Engr.

N. Y., Lockport—Niagara County considering construction of roads estimated to cost $700,000. T. Brennan, Supt., of Highways.

N. Y., Canandaigua—Ontario County contemplates appropriating sum of $330,000 for highways during 1923. Engineer not announced.

N. Y., Syracuse—Plans prepared for grading Lombard, Turtle, Spencer, Pulaski and No. Geddes St. Est. cost $101,100. T. M. Mather, City Engr.

N. C., Monroe—Election June 9th to vote on Union County road bldg. Lateral rds. and completion of bridges. Est. cost $500,000.

S. D., Burke—$91,000 received from Fed. and State Aid funds for hard surfacing Gregory Co. roads. Includes 14 miles bet. Burke and Dallas. Ludwig Trautman, Co. Aud.

Tenn., Martin—Bd. of Aldermen contemplate curbing, guttering and paving 13 miles of streets here.

Tex., Dallas—City voted $8,325,000 bonds for following impvts.: $5,000,000 for water works; $1,250,000 for st. impvts.; $500,000 for additional sewage disposal facilities; $150,000 for san. sewer; $100,000 for fire stations; $325,000 for parks and playgrounds; $1,000,000 for public sch. buildings.

Tex., Richmond—Ft. Bend Co., C. D. Myers, Co. Judge, considering paving 20 miles Old Spanish Trail—Harris Co. line to west line of Rd. Dist. No. 1. $550,000. C. H. Kendall, Co. Engr., Sugarland, Tex.

Tex., Sanderson—Terrell County plans to build 61 miles of gravel road on S. H. No. 12—Terrell to Val Verde to Terrell-Brewster Co. line. G. H. Henshaw, Co. Judge. Est. cost $600,000. Jno. Stovall, Co. Engr.

Tex., Sonora—Sutton County plans to grade and construct drainage structs. on 21.3 miles S. H. No. 4; also gravel surface additional 1.4 miles on S. H. No. 4 bet. Sonora and Edwards County line; $145,000. J. W. Alger, Co. Engr.

Tex., Sulphur Springs—Hopkins County plans to construct Jefferson and Bankhead Hwy. Considering voting on $2,000,000. W. W. Evans, Secy. Chamber of Com. or R. E. Bertram, Co. Judge, Sulphur Springs.

Vt., Barre—City will receive bids between May 15th and June 1st at office of Street Commissioners, City Hall for 7,000 sq. yds. rein. conc. paving, 1,700 linr. ft. drains, 8" to 29", depth 5" to 18': 2,000 sq. yds. paving and drain to be completed by July 1st, 1923. Est. cost $25,000. Sydney Lee Ruggles, Box 416, Barre, Engr. Further details and definite dates will be furnished by Engineer.

Va., Ft. Myer Heights—Arlington County Bd. of Supvrs., Jefferson District, plan concrete surfacing 10 roads as follows: .84 miles Bellefont Ave.—Washington to Alexandria Rd. and Russell Rd., $23,373; .085 mi. Mt. Vernon Blvd.—Alexandria Ave. to Alexandria corp. limits, $2,633; .194 mi. Braddock Rd., end of present conc. to Alexandria corp. limits, $4,414; .291 mi. Peyton Ave.—Del Ray Ry. sta. to DeWitt Ave., $8,113; .181 mi. Walfork Ave.—Del Ray Ry. sta. to Russell Rd., $5.616; .991 mi. Royal St., bet. Windsor and Washington Aves., bet. Alexandria & Hume Aves., $29,632; .17 mi. DeWitt Ave.—Hume to Wash. Ave., $20,900; .90 mi. Braddock Rd.—end of present conc. to Leesburg Pike, $25,221; .439 mi. Lloyd Ave.—Mt. Vernon Blvd. to Washington & Alexandria Rd., $12,166; 1.97 mi. Glebe Rd. bet. Arlington Dist. line to Washington and Alexandria Rd., $54,249. Plans to improve 9 additional sts., and 3.91 mi. Mt. Vernon Blvd.

Va., Luray—$150,000 appropriated by State Hwy. Comn. to construct 7 miles Lee Hwy.—Luray to top of Blue Ridge. H. G. Shirley, Commr.

Wash., Olympia—According to announcement made by State Hwy. Commr. James Allen, state hwy. program for 1923 will involve approx. expendt. of $4,465,000 to be used in constr. of primary highways and bridges. Completion of a number of contracts let last yr. will be made during the spring. Legislature has appropriated nearly two and a quarter million dollars for this purpose. Largest job to be undertaken is paving of 36½ mi. Pacific Hwy.—Toledo to Kalama. This work will be let in 7 contracts involving est. total cost of $1,380,000. Other contracts contemplated on Pacific Hwy. and their est. cost are: Grading and surfacing 8 mi. bet. Bellingham and Ferndale, Whatcom Co., $90,000; grading and surfacing 3 miles from Oyster Crk. no., Whatcom and Skagit Cos., $30,000; grading and surfacing 10 miles bet. Redondo & Milton, King Co., $160,000; grading and surfacing about 6 miles from Milton to Tacoma, Pierce Co., $80,000; paving 1¾ miles from Chehalis south, Lewis Co., $35,000; constr. of Salmon Crk. brdg., conc., Lewis Co., $35,000. This makes a total of $1,810,000 on Pacific Hwy. for this year. Olympic Hwy., will receive next largest amt., or total of $860,000.

W. Va., Clarksburg—Harrison County, Eagle Dist., plans to construct 8 roads. Approx. cost $549,665. For detailed information address County Commrs.

SEWERAGE AND SEWAGE TREATMENT.

Ark., Forest City—Forest City Special Impvt. Dist. contemplates voting on $115,000 bonds; $40,000 to be used in retiring indebtedness, remainder for extension to existing sewer system and disp. plant, bldg. power house and purchasing additional generating and pumping equipt. Fred J. Herring, Engr.

Ark., Mena—Village contemplates $40,000 bond issue to acquire sewer system and increase its scope.

Cal., Pasadena—City having plans prepared for construction of 20 miles of sewers. W. C. Earle, City Engr.

Cal., Paso Robles—State Bd. of Health has requested City (San Luis Obispo County) to take immediate steps to provide outfall sewer system. City Engr. W. W. Hughes authorized to appoint Cons. Engr. to design adequate treatment works.

Cal., Pomona—$100,000 sewer bonds voted here at recent elec.

Cal., Santa Ana—Co. Supervisors have adopted resolution for formation of san. district at San Juan Capistrano. Head, Rutan & Scoval, represented the petitioners.

Cal., Santa Clara—Will soon take vote on $70,000 bonds for outfall sewers.

Colo., Colorado Springs—City considering constr. of storm sewers in Dist. No. 3; 10,600 ft. 12-45 in. clay, cement or segmental blk. Est. cost $91,000. F. O. Ray, City Hall, Engr.

D. C. Washington—Dist. Commrs., 509 Dist. Bldg. plan sewers in various streets. Est. cost $150,000; also in suburbs at cost of $300,000; Commrs. are also planning Upper Potomac main interceptor at cost of $20,000.

Ill., No. Brooke—City plans to construct san. and storm sewers at cost of $130,000. Consoer Engrg. Co., 140 S. Dearborn St., Chicago, Engrs.

Mass., Springfield—Metcalf & Eddy, 14 Beach St., Boston, Cons. Engrs. on following impvts. here: Pumping sta., dikes and new sewer lines in Lowell, Orchard and Washburn Sts., to remedy flood conditions. Est. cost $200,000. City also contemplates 1.25 miles trunk line sewer in Eastern Ave. Est. cost $85,000. R. S. Marsh, City Engr.

Minn., St. Paul—Plans presented to City Council by Northern Pacific Ry. Company to carry Phalen creek thru R. R. Company's yd. Est. cost $395,420. G. M. Shepard, City Engr.

Mo., St. Joseph—City (Mayor McAnnich) plans to expend $2,000,000 for constr. of sewers, streets and recreational projects.

Mo., University City—$470,000 bonds voted for following impvts.: $200,000 for city parks; $45,000 bldg. and equipping fire engine house; $135,000 for bldg. sewer thru River des Peres Valley, etc. etc.

N. Y. Wanakah—Village plans to construct 2 miles sewer with disposal plant along lake front at cost of abt. $75,000.

N. C., Mt. Gilead—Plans prepared for sewerage

BUYERS' GUIDE

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Dynamite.
E. I. du Pont de Nemours & Co., Inc.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E. Mfg. Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

Expansion Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machin-
Good Roads Machinery Co., Inc.
ery Co.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Plants, Central.
American District Steam Co.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling & Harnischfeger.

Hoists, Electric .
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.

Incinerators.
William F. Morse.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
Carey Co., Philip, The.
The Texas Company.

Kettles (Portable).
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
The Barrett Co.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Co.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

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Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
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Pipe Cutters.
W. W. Stickler & Bros.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
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Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Powder (Blasting).
E. I. du Pont de Nemours & Co., Inc.

system, 3 septic tanks, 44,000 lin. ft. 6-15 in. vit. clay pipe, etc. Est. cost $69,000. H. Beebe, Spartanburg, S. C., Cons. Engr.

Ohio, No. Lima—Mahoning County (Youngstown) contemplates constructing modern san. sewerage system to cost $50,000. L. Fawcett, Court House, Youngstown, Co. San. Engr.

Ohio, Euclid—Mr. G. B. Gascoigne, Leader-News Bldg., Cleveland, Cons. Engr., preparing plans for sewage treatment works to be installed here. Est. cost $300,000.

Okla., Tulsa—City Comn. plans to expend $107,-921 to pave Haskell Pl.—Madison to Peoria—Frisco Addn. J. M. Crutchfield, Commr.

Pa., Elizabethtown—$60,000 bonds voted to pay share toward trunk sewers and sewage disposal plant at Masonic Home. Total est. cost $145,000. F. H. Shaw, Breneman Bldg., Lancaster, Engr.

Pa., Grove City—Bonds amounting to $50,000 voted for sewage disposal plant.

Tenn., McMinnville—Plans complete sewerage system. Est. cost $50,000. O. C. Jennings, Mayor.

Tex., Rosenberg—Atty. General's Dept., Austin, has approved $50,000 bond issue for san. sewer extensions and impvts. E. E. Sands, Mason Bldg. Houston, Cons. Engr.

WATER SUPPLY AND PURIFICATION.

Ala., Birmingham—City will expend about $60,633 for impvts. and extensions to water and light facilities; install 12-in. water main, $1,000 water meters, 800 electric meters, etc. W. L. Harrison, Commr. of Public Utilities, No. Birmingham.

Cal., Orange—Olive Impvt. Assn. proposes to enlarge Olive water facilities. Work involves increasing capy. of reservoir from 115,000 to 225,000 gals., also laying 6-in. water main from reservoir to "Four Corners." Work will involve approx. 3,000 ft. cast iron mains.

Cal., Petaluma—Petaluma Municipal Water Dist. plans to vote on $750,000 bonds for constructing water supply system, including storage dam, 3 diversion dams, pipe lines, flumes, canals, filtration plant, distributing system, etc. Howe & Peters, 24 California St., San Francisco and C. G. Hyde, 2575 Buena Vista Ave., Berkeley, Engrs.

Cal., San Bernardino—$140,000 bonds voted for water system. J. H. Osborn, City Clk.

Cal., San Diego—$325,000 bonds voted for cast iron mains and 1,200,000 gal. standpipe. F. A. Rhodes, City Engr.

Cal., Santa Ana—$150,000 bonds voted here at recent election for water system.

Ont., Fonthill—Water works system being considered, including cast iron pipe, mostly 6-in., hydrants, centrif. pumps and pump houses. Est. cost $40,000-$50,000. James, Proctor & Redfern, 36 Toronto, San., Engrs.

Ont., Hamilton—Plans being made for filtration basin chlorination plant. Est. cost $100,000. Prices desired on materials. E. R. Gray, City Engr.

Que., Levis—Plans being prepared for filtration plant costing $100,000. Lionel Lemieux, City Hall, Clerk.

Ont., Tisdale Twp.—Pumping plant and water supply being considered for So. Porcupine. Est. cost $250,000. J. F. Henderson, Timmins, Ont., Engr.

Ont., Windsor—Essex Border Utilities Comn. having plans prepared for filtration plant, slow sand or mechanical filters. Est. cost $300,000. Gore, Nasmith & Storrie, Confederation Life Bldg., Toronto, Cons. Engrs.

Fla., Fort Lauderdale—$90,000 bonds voted by City. $37,000 for water extension.

Fla., Gainesville—$300,000 voted for extensions and impvts. to sewer, water, light system and extension of street paving, etc.

Fla., St. Petersburg—Victory Land Co., Chas. R. Hall, Gen. Mgr., 476 First Ave., North St. Petersburg, plans 18-hole golf course. Equipment to consist of water mains and tower, power lawn mowers, septic sewage disposal plants and necessary equipment for water works and portable stone crushers.

Fla., Tampa—$1,272,278 bonds voted here to purchase water wks. plant and extend same. R. D. Martin, Engr., City Hall.

Ga., Decatur—$50,000 water bonds voted by city.

Idaho, Lewiston—Burns & McDonnell, 402 Interstate Bldg., Kansas City, Mo., are Cons. Engrs. for rebldg. and extending water works, including 4 m. g. storage capy., filtration sys., 2 reservoirs and replacing wood mains with cast iron pipe. Plans prepared. Est. cost $400,000.

Ill., Springfield—City will soon receive bids for a 5,000,000 gal. rein. conc. settling basin and 10,-000,000-gal. turbine centrif. pump. Burns & McDonnell, Interstate Bldg., Kans. City, Mo., Engrs.

Ky., Owensboro—City contemplates voting on $100,000 bonds for extension of water mains in Seven Hills, Buena Vista, Mechanicsville and on W. Main St.

La., Alexandria—City has acquired site and will construct additional reservoir for water works; capy., 2,750,000 gals.

La., Lecompte—W. H. Jones, Mayor—City voted $40,000 bonds for purpose of extending water works. Swanson-McGraw, Inc., Cons. Engrs., New Orleans, prepared plans.

La., Welch—Town contemplates completing water works system; also remodeling elec. light plant. Est. cost $115,000. Swanson-McGraw, United Fruit Bldg., New Orleans, Cons. Engrs.

Mich., Jackson—Preliminary plans prepared for water works extensions, including 3 m. g. storage reservoir, high pressure pumping station with boilers and equipt., high pressure mains, 6 drilled wells, 350 ft. deep. Low pressure equipment includes 15-in. motor-driven centrif. pump. $400,000. Hoad, Decker, Shoecraft & Drury, Ann Arbor, Mich., Engrs.

Mo., Lathrop—$60,000 water works bonds voted; $22,000 sewer bonds.

N. Y., Cobleskill—Village contemplates construction of new filter plant.

N. Y., Goshen—Plans being considered for constr. of reservoir in "Dutch Hollow" at cost approximating $240,000.

N. C., Mt. Gilead—Surveys made for 25,500 ft. 6/10-in. cast iron; also 3,800 ft. 2-in. w. i. mains, filter plant, 2 pumping stations, supply lines, reservoir, clear well, dam, pumping machinery and elevated tank, $84,324. H. Beebe, Spartanburg, S. C., Cons. Engr.

N. C., Burlington—City will issue $420,000 bonds for reconstructing surface of streets, including constr. of gutters and drainage, grading; constructing sewer and water service, extending present water and sanitary system. N. W. McPherson, City Clerk.

N. C., Charlotte—City will issue $300,000 water extension bonds for completion of new filter plant and pumping station, extension of present water system, etc. Edgar Read, City Clk.

N. C., Saluda—Plans and ests. prepared for 1 mile pipe line, 200,000 gal. reservoir and pumping equipt. H. Beebe, Spartanburg, S. C., Cons. Engrs.

N. C., Walnut Grove—City Commrs. have authorized bond issue of $100,000 for developing water power on Dan River, supplying electric current for town and installing water and sewer system.

O., Rocky River—Prelim. plans being made for water supply for villages of Rocky River, Dover and Bay (Dover, P. O.). Est. cost $300,000 G. B. Gascoigne, Leader-News Bldg., Cleveland, Engr.

Okla., McAlester—City will probably vote on $400,-000 bonds for constr. of aqueductor pipe line from McHoma Lake to City, and installation of filtr. plant and auxiliary pumps.

Okla., Tonkawa—Plans prepared for water works impvts. $70,000 bonds voted. Ruckel Engrg. Co., Interurban Bldg., Hutchinson, Kans., Engrs.

Pa., Dubois—City will construct 4,000,000 gal. storage reservoir and raise the splash-board of the Anderson Creek reservoir 2 ft. Est. cost of impvts., $135,000.

S. C., Cowpens—Surveys made for cast iron mains, pump house, reservoir, elevated talk, pumping equipment and deep wells. Est. cost $60,000. H. Beebe, Cons. Engr., Spartanburg.

Wis., Phillips—City will sell $40,000 worth of bonds for pumping station for water supply.

Wis., Portage—Meeting held to discuss water works plant. About $100,000. Est. cost of wells, $50,000. C. J. Loomis, City Clk.

Wis., Woodville—Will probably take bids this spring for sewers and waterworks; 80,000 gal. tank, deep well, tanks, pump, etc. Est. cost $45,000. Cons. Engrs. Druar & Milinowski, 500 Globe Bldg., St. Paul.

BUYERS' GUIDE

Pumps.
De Laval Steam Turbine Co.
Evinrude Motor Co.
Harris Air Pump Company.
Keystone Driller Co.
Smith Co., T. L., The

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Kentucky Rock Asphalt Co.
The Texas Co.

Road Binder.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Keystone Driller Co.
Littleford Brothers.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The

Road Oil and Preservatives.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co.
The Good Roads Machinery Co., Inc.

Roofing Material.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros. Co.

Sand Dryers.
Cummer & Son Co., The F. D.
Littleford Brothers.

Saw Rigs.
C. H. & E. Mfg. Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling & Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co., The

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Sewer Pipe Joint Compound
The Barrett Co.

Sewer Rods.
Stewart, W. H.

Slide Rules.
Kolesch & Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.
Phoenix Mfg. Co.

Special Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co., The

Stone Elevators.
Austin-Western Road Machinery Co., The

Stone Spreaders.
Austin-Western Road Machinery Co., The
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co., The
Littleford Bros.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Paving Material.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Road Machinery Co., The

Surface Heaters
Chausse Oil Burner Co.

Subgrading Machines
Austin Machinery Corp.
The Hug Co.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Tamping Machines.
Pawling & Harnischfeger.

Tanks, Water Supply.
Littleford Brothers.

Tar and Pitch
The Barrett Co.

Tar Heaters.
Littleford Brothers.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith.
Walter H. Flood.
Howard, J. W.
Kirschbraun, Lester.
Van Trump, Isaac.

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
Austin Machinery Corporation.
Holt Mfg. Co., Inc.

Traffic Signals.
Little Giant Co.

Trailers.
Lee Trailer and Body Co.

Trench Braces.
Kalamazoo Fdry. & Mach. Co.

Trench Machinery.
Austin Machinery Corporation.
Kalamazoo Fdry. & Machine Co.
Pawling & Harnischfeger.

Tool Heaters, Asphalt
Chausse Oil Burner Co.

Turbines, Steam.
De Laval Steam Turbine Co.

Turntables, Truck
The Hug Co.

Valves.
Coldwell-Wilcox Co.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Main Cleaning.
National Water Main Cleaning Co.

Water Pipe.
U. S. Cast Iron Pipe & Foundry Co.

Waterproofing.
Barrett Co., The
Pioneer Asphalt Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

Water Softener.
The Refinite Co.

Water Works Supplies and Equipment.
Coldwell-Wilcox Co.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Wire Rope.
American Steel & Wire Co.

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

Wood Block (Creosoted).
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Wood Preservatives.
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—Dragline Cableway Excavator
—Dump Cars
—Dump Wagons
—Excavator, Crane
—Elevating Graders
—Gasoline Locomotives
—Gravel Screener
—Heaters, Asphalt
—Heaters, Tar
—Hoisting Engines
—Industrial Cars
—Industrial Track
—Manhole Covers
—Mixers, Building
—Mixers, Hot
—Mixers, Paving
—Motor Trucks (1-3 tons)
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—Road Forms
—Road Graders
—Road Mesh
—Road Planes
—Road Plows
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—Road Scrapers
—Sand Dryers
—Saw Rigs
—Scarifiers
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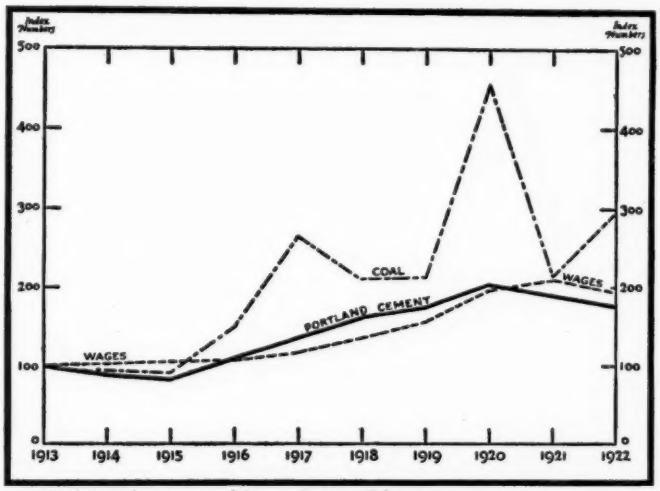
—Skimmer, Scoop
—Steam Shovels
—Stone Elevators
—Stone Screens
—Stone Spreaders
—Surface Heaters
—Tampers, Road
—Tractors
—Trailers
—Turntables
—Unloaders, Car
—Wagon Loader
—Wheeled Scrapers
—Wire Mesh



Coal prices from Survey of Current Business, February, 1923.
Cement prices from U. S. Geological Survey.
Wages, from November (1922) Monthly Labor Review, Bureau of Labor Statistics.

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By measuring things against each other as our grandmothers did when they swapped eggs for calico, we get the clearest idea of values.

Coal and wages make up more than half the manufacturing cost of cement.

The chart above shows price fluctuations for portland cement, coal and wages during the past ten years. In each case 100 is used to represent 1913 figures, by the Government departments which compiled these statistics.

Translated into "eggs and calico" language this chart shows that a ton of coal would buy nearly twice as much cement in 1922 as in 1913. A day's wages also would buy more cement in 1922 than in 1913.

This means that even though coal and wages make up more than half its manufacturing cost, cement is now relatively lower in price than either coal or wages.

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—Concrete Hoisting Equipment
—Concrete Tanks
—Condensers
—Conduit Rods
—Cranes, Locomotive
—Cranes, Traveling
—Curb Boxes
—Curb Cocks
—Derricks, Pipe Laying
—Derricks, Steel Portable
—Drinking Fountains
—Dry Feed Chemical Apparatus
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—Engines, Gas
—Engines, Oil
—Engines, Pumping
—Explosives
—Fence, Iron
—Fittings, Wrought
—Filter Equipment
—Gates, Sluice
—Gauges, Recording
—Gauges, Steam
—Gauges, Water
—Goose Necks
—Hydrants, Fire
—Indicator Posts
—Lead
—Leadite
—Lead Furnaces
—Lead Wool
—Leak Indicators
—Liquid Chlorine
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—Meter Boxes
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—Oil, Lubricating
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—Pipe Cutters
—Pipe, Lead-Lined
—Pipe, Steel
—Pipe, Wrought Iron
—Pipe, Wooden
—Pitometers
—Pumps, Air Lift
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—Pumps, Centrifugal
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—Pumps, Turbine
—Pumping Engines
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—Soda Ash
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—Standpipes
—Steam Boilers
—Steel, Reinforcing
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—Tamping Machines
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—Water Main Cleaners
—Water Meters
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—Welding Apparatus
—Well Drills
—Well Screens
—Well Strainers

The cost of a pavement is the cost of CONSTRUCTION *PLUS* the cost of MAINTENANCE

A PAVEMENT is either an asset or a liability. Saddling a community with a pavement that demands constant and expensive maintenance is not economy. A road is "improved" only when it is built for an endurance which will outlast the bonds.

NATIONAL PAVING BRICK
MANUFACTURERS ASSOCIATION
ENGINEERS BLDG. CLEVELAND, OHIO

MODERN economical road construction calls for an "ABC" pavement.

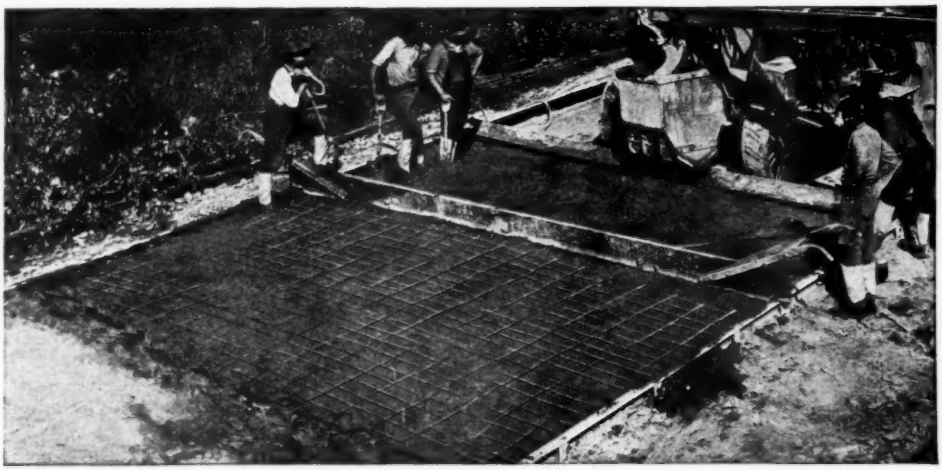
Have you the full details and reasons for this pavement in your files?

Complete specifications gladly furnished on request.

VITRIFIED **Brick**
OUTLAST THE BONDS

These manufacturers with 55 conveniently located plants will be glad to serve you.

Albion Shale Brick Company
Albion, Ill.
Alton Brick Company
Alton, Ill.
Barr Clay Company
Streator, Ill.
Binghamton Brick Company
Binghamton, N. Y.
Cleveland Brick & Clay Company
Cleveland, Ohio
Clydesdale Brick & Stone Co.
Pittsburgh, Pa.
Coffeyville Vitrified Brick & Tile Co.
Coffeyville, Kans.
Collinwood Shale Brick Company
Cleveland, Ohio
Corry Brick & Tile Company
Corry, Pa.
Francis Vitric Brick Company
Boynton, Okla.
Georgia Vitrified Brick & Clay Co.
Augusta, Ga.
Globe Brick Company
East Liverpool, Ohio.
Hammond Fire Brick Company
Fairmont, W. Va.
Hocking Valley Brick Company
Columbus, Ohio.
Independence Paving Brick Co.
Independence, Kans.
Mack Mfg. Company
Wheeling, W. Va.
C. P. Mayer Brick Company
Bridgeville, Pa.
Medal Paving Brick Company
Cleveland, Ohio.
Metropolitan Paving Brick Co.
Canton, Ohio.
Metropolis Paving Brick Co.
Pittsburg, Kansas.
Mineral Wells Paving Brick Co.
Mineral Wells, Texas.
Moberly Paving Brick Company
Moberly, Mo.
Murphysboro Paving Brick Co.
Murphysboro, Ill.
Patton Clay Mfg. Company
Patton, Pa.
Peebles Paving Brick Company
Portsmouth, Ohio
Pittsburgh Paving Brick Company
Pittsburgh, Kansas.
Purington Paving Brick Company
Galesburg, Ill.
Southern Clay Mfg. Company
Chattanooga, Tenn.
Springfield Paving Brick Company
Springfield, Ill.
Sterling Brick Company
Olean, N. Y.
Streator Clay Mfg. Company
Streator, Ill.
Thornton Fire Brick Company
Clarksburg, W. Va.
Thurber Brick Company
Ft. Worth, Texas.
Toronto Fire Clay Company
Toronto, Ohio
Trinidad Brick & Tile Company
Trinidad, Colo.
Veedersburg Paver Company
Veedersburg, Ind.
Western Shale Products Company
Fort Scott, Kans.
Westport Paving Brick Company
Baltimore, Md.



Palestine Road, Darlington County, Pa. Chester Contracting Co., Contractors.

Leading Highway States Reinforce Concrete Roads

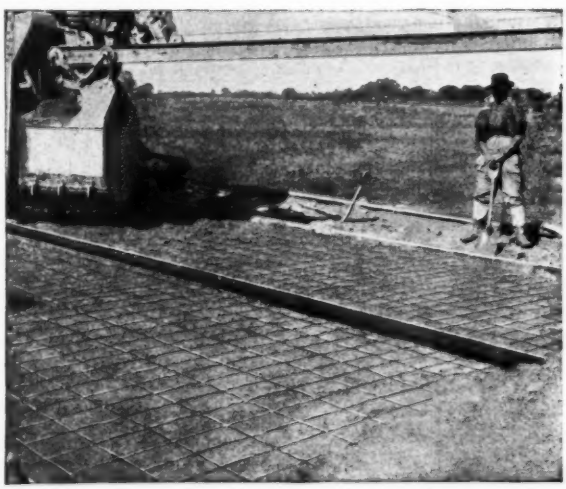
The necessity of steel reinforcement in concrete roads is now generally recognized by leading engineers. The State Highway Departments of New York, Pennsylvania, New Jersey, Ohio, Maryland, Minnesota, Iowa, Florida, North Carolina, California and others, are specifying steel wire mesh in flat sheets.

TRUSCON WIRE MESH

Furnished in widths and areas as desired, in flat sheets. Members are rigidly connected so that mesh remains in perfect form during handling. The sheets are manufactured with the main members spaced 6 inches on centers, and the secondary members spaced 12 inches on centers. Cut in any desired length.

TRUSCON STEEL CO., Youngstown, Ohio

Warehouses and Offices from Pacific to Atlantic.
For address see phone books of principal cities. Canada: Walkerville, Ont. Export Division: New York.

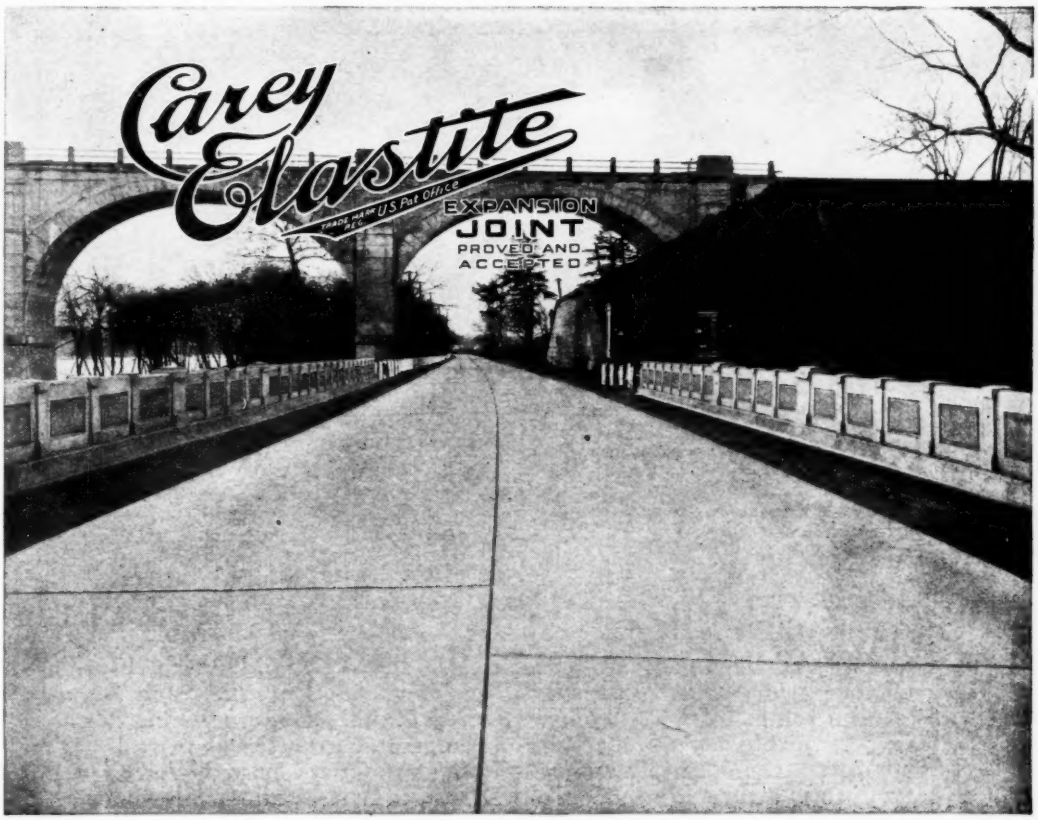


Southfield Road, Oakland County, Mich. R. D. Baker Co., Contr., L. V. Belknap, Eng. A central contraction joint was placed in this road.

TRUSCON CONTRACTION JOINTS

16-gauge plate, rigid, substantial, easy to install. Provides a definite plane of weakness in pavement that forms a straight crack for contraction or expansion. Central joints also serve as traffic markers.

TRUSCON STEEL CO
TRUSCON
HIGHWAY PRODUCTS



Mercer County Highway near Trenton, New Jersey. H. F. Harris, County Engineer, Ross & Whelan, Inc., of Trenton, N. J., Builders. Elastite Expansion Joint used.

Good roads—good reputations

A GOOD road, completed on schedule according to contract, means full profit to the contractor and another success added to the engineer's record.

Expansion joint is the smallest item on the road material bill, yet non-delivery or delayed delivery may hold up the whole job. It doesn't pay to take a chance on any other joint when you can always be sure of getting Elastite Expansion Joint when and where you want it.

The annual production capacity of the Carey factory making Elastite Expansion Joint is greater than the total national consumption of preformed expansion joint! Also, big stocks are carried at seventeen distributing centers to give quick shipment on all orders.

Send for more information and a sample.

The wide demand for Elastite Expansion Joint over many years has made possible the creation of factory and distributive facilities that assure prompt deliveries anywhere in any quantity.

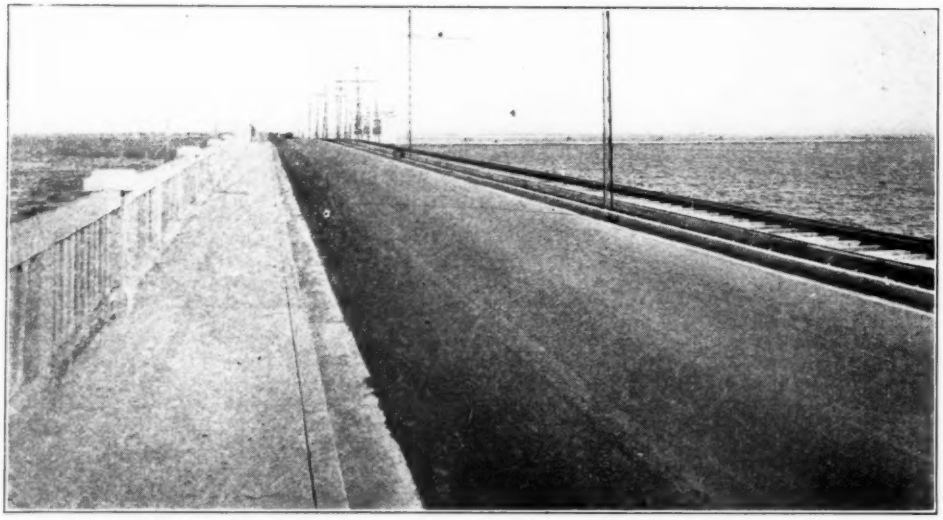
THE PHILIP CAREY COMPANY

40 Wayne Ave., Lockland, Cincinnati, Ohio

1873—Fifty Years of Progress—1923

Carey Elastite Expansion Joint is an asphaltic body, formed of a high-grade asphaltic compound carefully refined and tempered, sandwiched between two walls of asphalt-saturated felt forming an elastic, compressible joint. It is made in lengths, widths and thicknesses as required, can be cut to crown or to any special shape and comes to the job ready to use.

6-23



Kyrock on the Causeway at Miami Beach

This causeway carries the traffic between Miami and Miami Beach, Florida—from 8,000 to 10,000 vehicles a day. It was paved in December and January, 1919–20, with Kentucky Rock Asphalt—Kyrock brand. Despite the heavy traffic, the Kyrock surface today is in perfect condition—free from cracks or rolls. This is only another example of how Kyrock stands up under heavy duty. Kyrock is giving uniformly successful service from Detroit to Miami and from Chicago to New Orleans.

Kyrock produced by the Kentucky Rock Asphalt Company today is the same, by actual test, as the surface on the Miami Beach causeway. The deposits of natural asphalt rock are first core-drilled and tested. Next the quarry face is carefully analyzed and finally each ton of the pulverized asphalt is subjected to laboratory test. This means uniformity. Kyrock is not subject to damage or changes when exposed to the elements. Every car of Kentucky Rock Asphalt shipped by this company gives uniformly successful results, if laid on a properly prepared foundation sufficient to carry the traffic.

* * *

Kyrock is the engineer's and contractor's insurance of uniformity, quality and service.

The largest and oldest producer of Kentucky Rock Asphalt, this company is experienced in the many difficulties of getting this natural paving material from the rugged hills. A storage of from 35,000 to 40,000 tons, in addition to our big daily production, assures prompt delivery. No orders are accepted in excess of our known ability to make shipments.

* * *

Our engineering department keeps in close touch with all Kyrock construction to cooperate with engineer and contractor and insure successful pavements. Kyrock service begins when the plans are made and does not end until the work is satisfactorily completed.

* * *

We have prepared typical cross-sections and specifications for Kentucky Rock Asphalt construction on all standard bases. These are available for state, county and city engineers. Our literature fully describes Kyrock production and construction.

Write for Booklet E-5

Kentucky Rock Asphalt Co.

(INCORPORATED)

711-717 Marion E. Taylor Bldg. Louisville, Ky.

Arcadian Post with Sol-lux Top, having Glass Canopy and Ornamental Band, installed at Chillicothe, Illinois.

Civic Pride

when backed by sound business judgment, is the powerful force responsible for better cities—and better business.

A Westinghouse - Cutter Ornamental Street Lighting System is a good investment for any town, yielding a fine return in increased business. It stimulates interest at home and attracts the outsider.

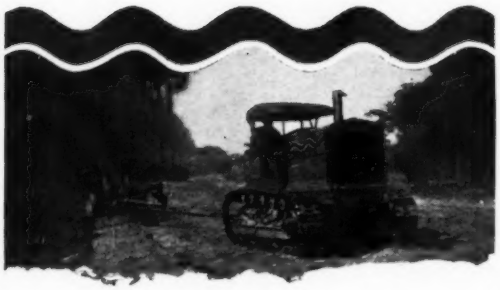
When buying street lighting equipment, it is advisable to get a well-balanced whole rather than to shop around and attempt to assemble parts.

Write for Circular 1642.

Westinghouse Electric & Manufacturing Co.

George Cutter Works, South Bend, Indiana.

Westinghouse



Conquering the Everglades

Through the very heart of the Florida Everglades, world-famed as an impenetrable swamp, indomitable road-makers are now pushing the 250-mile Tamiami Trail. Cities and officials all along the route are keenly interested in the early completion of this trail at lowest possible cost. That's why "Caterpillars"* are so prominent on the job.

C. T. Friend, chairman of the county commissioners at Tampa, says: "Our third "Caterpillar"* is now at work, grading the Hillsborough County end of the Tamiami Trail. From the standpoint of upkeep, service and general satisfaction, we feel our investment in these machines has been a mighty good one."

"Caterpillars"* have the traction needed for uninterrupted operation over the sandy, boggy places. Their superior speed and endurance means too, that this highway *is* being completed in the shortest time and at the lowest possible cost. Let us show you how the "Caterpillar"* can build and maintain *your* roads with important savings of tax funds.

******There is but one "CATERPILLAR"—Holt builds it*

THE HOLT MFG. COMPANY, *Inc.*
PEORIA, ILLINOIS

BRANCHES AND SERVICE STATIONS ALL OVER THE WORLD

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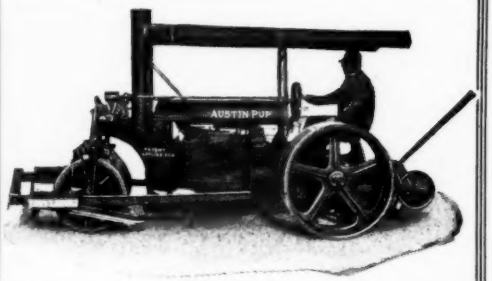
CATERPILLAR
Reg U.S. Pat. Off.

HOLT
PEORIA, ILL.
STOCKTON, CALIF.



The AUSTIN PUP

Weight, 3, 3½ or 4 Tons.

The **Austin Pup Roller and Road Maintainer** is the undoubted sensation of the road and street building and maintenance fields. Exhibited for the first time at the January Chicago Road Show, where it attracted far more than its proportionate share of attention; it is rapidly becoming one of the most popular tools with both contractors and public officials of all classes, from State to Township and from City to Village. The reason for such universal popularity is obvious: The Pup adapts itself perfectly to a surprisingly wide range of work, and in every case clearly surpasses former methods. The brief excerpt below, from one of the many letters already received from enthusiastic users, shows how adaptable The Pup has already proved itself to be, and new uses are being discovered almost daily.

F. E. Ross, City Engineer of Jefferson, Mo., writes that

"Our **Austin Pup** was purchased to be used for repairing and patching bituminous macadam streets. It has been in use almost every working day since we received it and is giving the best of satisfaction. Before buying the roller we had all patches tamped. The tamping was the most expensive part of the work, wore the men out and took about three-fourths of their time. Since we received the roller the same crew is doing about four times as much work as before, is doing 100 per cent better work and at a saving sufficient to more than pay for the roller this season."

Write today for a copy of Bulletin "O" which tells the whole story of the **Austin Pup** and its many uses.

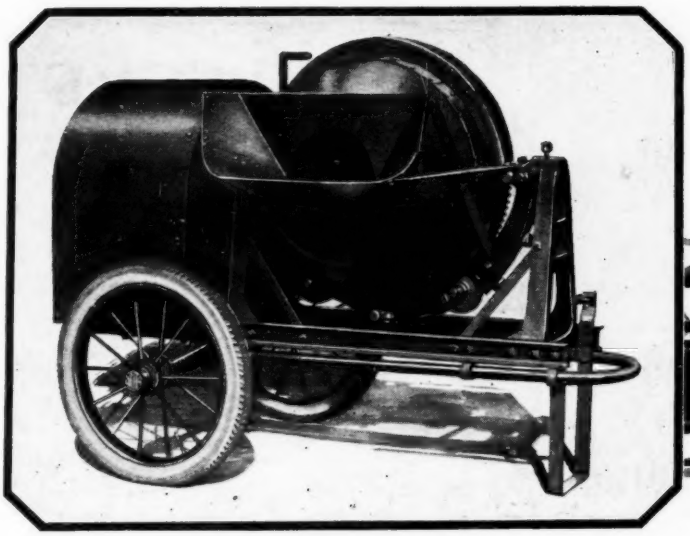
The Austin-Western Road Machinery Co.

Factories and Home Office: CHICAGO.

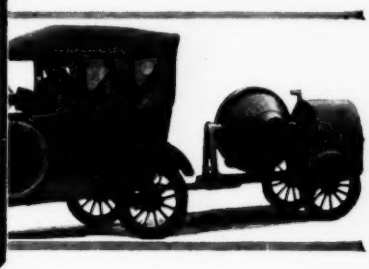
BRANCHES EVERYWHERE

EXPORT DEPARTMENT
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA

"Everything from a Drag Scraper to a Road Roller"



THE NEW SMALL SMITH TILTER



Our Contractor Friends Were Right

What we said in our previous announcement of the Smith 4-S Tilting Mixer, about contractors' interest in this new product, has been further substantiated by orders placed.

Although provision has been made for quantity production it has been necessary to increase the weekly output at once.

With the merit of Smith Tilting construction Mixers so universally known, the value of the all-around Smith 4-S Tilter was recognized at once.

Examine this Mixer. The typical Smith Tilting Drum fitted inside with blade design to give the same thoroughness of mix as the larger Smith Tilter; the machine-cut engine gears; the unusual and simple tilting mechanism; the Fuller and Johnson engine with magneto, completely housed.

Thorough Factory Inspection

There is not a Smith Mixer that is given a more thorough inspection. Parts made to the closest micrometer tolerance of any Smith machines and the complete machine given a final rigid inspection.

Quantity Production Lowers Price

Having been told of the need for a good small mixer of the same quality as larger Smith Mixers, we were not hesitant about making provision for quantity production of the new 4-S. First estimates showed that the price would have to be close to $350.00, but through the efficient shop methods and production of duplicate parts in quantities, savings were made which permit making a considerably lower price.

If present material and labor costs increase, the price now set may have to be increased. Your order should, therefore, be placed now.

THE T. L. SMITH COMPANY

1183 32nd Street **Milwaukee, Wis.**

New York Office and Warehouse: 50 Church St.
Chicago Office: Old Colony Building.
Western Warehouse: Oakland, California.
Offices and Agents in Principal Cities.

SMITH MIXERS

Smith 4-S Tilting Mixer—Four-Wheel Model S W-1, Charging Side with Feed Chute and Low Charging Platform.

Smith 4-S Tilting Mixer with Feed Chute, Four-Wheel Model SW-1, Discharge Side—Tilting Lever locks in Discharge Position. Drum Returns Automatically when Lever is Released.

Please Give Complete Address

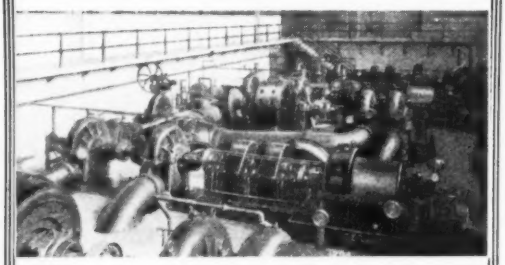
The T. L. Smith Company, Milwaukee, Wis.

GENTLEMEN: Send leaflet, prices and approximate date of delivery of the new Smith 4-S Tilting Mixers.

Name _____

Address _____

City and State _____



Records Made at Toronto by De Laval Pumps

THE John Street Pumping Station at Toronto contains three De Laval Geared Turbine Driven Centrifugal Pumps having a capacity of 24,000,000 Imperial gal. each against 250 ft. head. The first unit installed was designed for a capacity of 15,000,000 Imperial gal. per day, but provision was made for changing the capacity later to 24,000,000 Imperial gal. per day. This first unit, when tested by Prof. R. W. Angus in the year 1914, set the high record of 130,449,000 ft. lb. per 1000 lbs. of steam when pumping at a capacity of 15,000,000 gal. per day, which duty had never before been reached by a steam turbine driven pump. One of the 24,000,000 gal. pumping units when tested by Prof. Angus in 1917, however, put the record up to 153,920,000 ft. lb. per 1,000 lb. of steam, which has only lately been surpassed by De Laval units of somewhat larger capacity and power. Efficiencies of over 87% were obtained at the official tests made by Prof. Angus of four 20,000,000 Imperial gal. per day motor driven De Laval pumps for 250 ft. head, recently installed at Toronto. The De Laval Steam or Electric Driven Centrifugal Pump is the most economical means for handling water.

Ask for book W-92.

De Laval
Steam Turbine Co.

Trenton, New Jersey

Local Offices—Atlanta, Birmingham, Boston, Charlotte, Chicago, Cleveland, Dallas, Denver, Duluth, Indianapolis, Kansas City, Los Angeles, Montreal, New York, New Orleans, Philadelphia, Pittsburgh, Salt Lake City, San Francisco, Seattle, Toronto.

LITTLEFORD
Tar and Asphalt Heaters

STYLE No. 69

Small Portable Tar and Asphalt Heaters are indispensable as part of the equipment necessary for maintaining roads and streets. Littleford Heaters are made expressly for this work.

Send for Catalogue.

LITTLEFORD BROS.

460 E. Pearl St. Cincinnati, Ohio

PIONEER Highest Quality ASPHALTS

PIONEER Highest Quality ASPHALTS

Filler Asphalt

The ideal brick pavement filler. Made to meet the strictest specifications. Low prices and immediate delivery on any quantity.

"PIONEER"

Every monolithic pavement should have an Expansion Joint. **"Pioneer"** is made from an absolutely pure asphalt, giving maximum expansion and contraction efficiency.

Expansion Joint

THE PIONEER ASPHALT CO.

LAWRENCEVILLE, ILL.

Are you sure you are getting the most for the least?

. . . to provide each user with the particular explosive that will do *his work* best and at least expense. That principle is the foundation of the du Pont Company's success—

and is saving thousands of dollars for du Pont customers.

Du Pont Explosives Service can save money for *you*, too.

Nitroglycerin, ammonia, gelatin and other types of explosives designed to meet every blasting requirement at least expense.

The du Pont Chemical Engineer — symbol of progress and leadership in the manufacture of products based on Chemistry.

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Designing and Consulting Engineer
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Special courses laid out by Engineer with 30 years experience for technical men who need more practical work than college provides. *Steel Designing; Reinforced Concrete Design; ESTIMATING; Bridges.*
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HYDRAULIC ENGINEER AND SANITARY EXPERT
50 Church St., New York City
Sewerage and Sewage Disposal, Water Supply and Purification, Water and Electric Power.
Valuations of Existing Plants where MUNICIPAL OWNERSHIP is Contemplated—Expert Testimony—Plans and Estimates.

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—reach city officials by inserting professional cards in this Department.
A Daily Bulletin, covering prospective work in all parts of the country, goes free to each advertiser. Write for rates and full information to
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Sewer Pipe—Drain Tile—Steam and Electric Conduits—Building Tile—Fire Brick
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Guaranteed not to Rattle or Dish.
Full Line of MANHOLE and CATCH BASIN COVERS of all kinds.
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ENGINEERING CHEMIST
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HERE is just the type of power drag scraper outfit—inexpensive, easily moved from place to place—that owners of small gravel pits, county highway commissioners and contractors have been looking for. Write for folder.
Sauerman Bros., 458 S. Clinton St. CHICAGO
SAUERMAN PORTABLE POWER SCRAPER delivering gravel to a small screening plant

JAMES P. WELLS, HYDRAULIC ENGINEER
Surveys, Estimates of Cost of Proposed Work, Reports on New Improvements, Preparation of Plans, Supervision of Construction, Dams and Reservoirs, Pipe Lines, Filtration Plants, New Water Supply Systems, Hydro-Electric Power Plants.
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New Automatic Cement Tester
Grand Prize Panama-Pacific International Exposition, 1915.
Manufacturers of Cement, Concrete, Brick and Road Material Testing Machines and All Auxiliary Laboratory Apparatus
TINIUS OLSEN TESTING MACHINE CO. 500 North Twelfth St. PHILADELPHIA, PA.

SEWER PIPE — FIRE BRICK
Flue Linings — Wall Coping — Steam Line Conduit — Sewage Disposal Tanks — Fire Clay Meter Boxes
IN STRAIGHT OR MIXED CARS. Manufactured of OHIO RIVER FIRE CLAY.
CANNELTON SEWER PIPE CO., Cannelton, Ind.

Street Injured by Leaking Main

The penalty for installing inferior pipe for water mains will always be heavy. Aside from the loss of water and the increased cost of pumping, due to leakage, officials must consider the probability of torn up streets and the danger of property damage.

Bell and spigot cast iron pipe properly installed is leak-proof, which is one reason why it has been the standard in water works installations for decades.

United States Cast Iron Pipe & Foundry Co.

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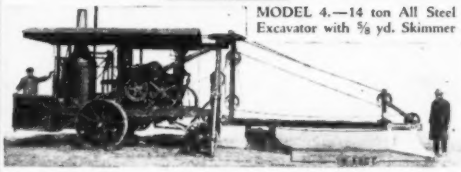
STEAM KEYSTONE SHOVELS



MODEL 4.—14 ton All Steel Excavator with ⅝ yd. Skimmer

The KEYSTONE is a highly versatile traction steam shovel with all the efficiency of specialized design, usable with three different interchangeable scoops—*Skimmer, Ditcher and Clam Shell*—for Road Grading, Trenching, Back-Filling, Cellar Digging, Pit Mining, Loading, Unloading and Handling Materials. Can be equipped with electric motor drive for use in buildings. Saves first cost, moving cost and upkeep and is readily sold or rented for any sort of excavation job. A reliable road shovel of remarkable adaptability to other uses.

The heavy Keystone Skimmer Bucket, ⅝ yd. capacity, has a horizontal crowd of 14 feet and fills itself at one shot on a six inch cut. It leaves a smooth surface, finished to grade and thus dispenses with costly hand-trimming. Shallow digging in hard material—old macadam, paving blocks, concrete and asphalt—is keystone work.
Made in two sizes: Model 1, 10 ton and Model 4, 14 ton. The good Keystone Digging Ideas in our catalogs and advertising sheets have made money for 1500 Contractors in the United States. Ask for them.

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Model 4, with Boom extension and ½ yd. Clam Shell Bucket

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Cuts either Cast or Steel pipe. Cuts a channel in the pipe same as a lathe cut.

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